A BOOK ON
IODINE DEFICIENCY DISORDERS (IDD) IN GUJARAT
AND PROCEEDINGS OF
WORKSHOP CUM SEMINAR ON ' IDD IN GUJARAT '
(8th January 1994)

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DR. PRADEEP KUMAR

[A UNICEF ASSISTED PROJECT]

DEPARTMENT OF PREVENTIVE AND SOCIAL MEDICINE

Government Medical College, Surat (India) - 395 001.

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[A UNICEF ASSISTED PROJECT]

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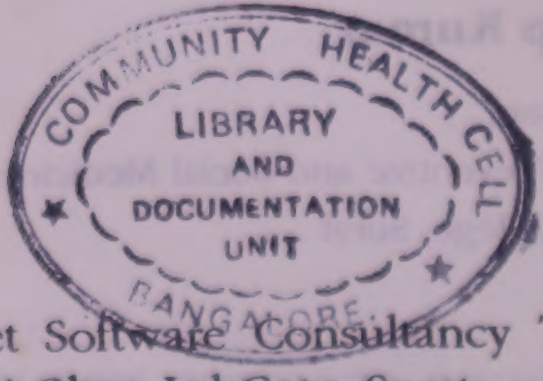

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' Iodine deficiency is so easy to prevent that it is a crime to let a single child be born mentally handicapped for that reason '

(Executive Director, UNICEF, 1978)

PREFACE

Iodine deficiency is a risk factor for the growth and development of people living in deficient environment throughout the world. Its effect on growth and development, called Iodine Deficiency Disorders (IDD) comprises goitre, stillbirth and miscarriages, neonatal and juvenile thyroid deficiency dwarfism, mental defects, deafmutism and spastic weakness and paralysis as well as lesser degrees of loss of physical and mental functions.

Goitre - enlargement of thyroid gland due to the iodine deficiency, has been a known health problem since antiquity in India specially in its sub Himalayan belt which extends for 2,400 kms from Jammu and Kashmir in the west to Arunachal Pradesh in the east. In addition to it, goitre as well as other IDD are now being increasingly reported from other places, often referred to as "Extra Himalayan Foci" of endemic goitre. Identification of IDD in the community is important as they are fully preventable and with minimum efforts (mass iodisation of salt), spectacular results can be obtained.

A seminar cum workshop was organised on "Iodine Deficiency Disorders in Gujarat" at the Department of Preventive and Social Medicine, Government Medical College Surat on 8th January 1994. It was attended by more than 100 participants including teachers from Medical Colleges, Food and Nutrition Deptts of Home science Colleges, health officials from district and state level organisations, salt manufacturers and representatives of NGO. It included several lectures delivered by experts and presentations of around 30 research works on related areas. Four separate working groups were formed which dealt with (1) Training and Manpower development (2) Programme Planning, Implementation and Legislative support (3) Development of Regional Laboratories and (4) Community Participation. These groups deliberated on assigned topics and made specific recommendations.

We are publishing the proceedings of this workshop with the belief that the information contained in it will be useful to research workers, health planners and teachers of this speciality.

SURAT **(V. K. Desai)**

30th November, 1995 **(Pradeep Kumar)**

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for their financial assistance and to

(6) Epidemic Section Health Commissionerate, Gujarat State Gandhinagar,

(7) Dean Govt. Medical College, Surat and

(8) Indian Association of Preventive and Social Medicine Gujarat Chapter

for their guidance and encouragement for the organisation of this seminar cum workshop.

We will be failing in our duties if we do not acknowledge the contributions of Dr. S L Kantharia, Dr. J K Kosambiya and Mr. R R Chokshi (all from PSM Dept.), other staff members and postgraduate students of PSM Department without which it would not have been possible to organise this workshop.

We thank UNICEF Gujarat office and its Project-Officer Dr. S. Nirupam for technical guidance and financial assistance which enabled us to prepare this document.

Lastly we are thankful to Dr. M. Moitra (PSM Dept.) for her assistance in the editing work of this document.

SURAT
30th November, 1995

(V. K. Desai)
(Pradeep Kumar)

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IDD RELATED RESEARCH AND SERVICE ACTIVITIES OF

Preventive and Social Medicine Department, Government Medical College, Surat.

1980 Goitre Survey in school children of Vyara and Songadh taluka.

1985 A study of IDD in adolescent girls, pregnant women and neonates exposed to various levels of environmental iodine concentration in Surat district, Gujarat.

1986 A study of goitre and associated health consequences - ICMR Multicentric study.

1986 Preparation of slide set for training.

1986 Preparation of video film "Goitre in Gujarat" sponsored by Surat District Co-operative Bank, Surat.

1986 Epidemiological studies of IDD in tribal population of Surat district.

1986 onwards

Participation in IDD training programme for local leaders and paramedial workers at Bharuch, Valsad and four talukas of Surat district organised by District Health Office.

1994 Organisation of one day state level seminar / workshop on IDD in Gujarat for teachers of related specialities of Medical Colleges and Home Science colleges of Gujarat.

1995 Monitoring of Iodised salt consumption in Surat and Dang district UNICEF project.

1995 Publication of proceedings of the workshop / seminar on IDD in Gujarat.

IDD - STATE SCENARIO

1. GOITRE SURVEY IN GUJARAT

In Gujarat the problem of Goitre was first reported in 1914 by Sir McCarrison in Narmada valley region. Later on independent scientific studies were conducted thrice in Bharuch district by different teams between 1972 and 1979 (Edibam et al 1972, Agrawal et al 1979, Trivedi et al 1979).

Desai (1980) reported a study of goitre prevalence in school children of Songadh taluka of Surat district.

A multicentric ICMR study on Goitre and associated health consequences at Surat Centre was successfully completed in 1986 under principal investigatorship of Dr.(Mrs.) Vikas Desai.

Similarly multicentric salt consumption pattern study was conducted for Bharuch and Baroda districts in 1988 under principal investigatorship of Dr.D.N.Shah.

Districtwise goitre baseline survey activity as a part of National Goitre Control Programme (NGCP) was initiated by central team in 1972 in Gujarat State. NGCP team of Director General of Health Services, Delhi surveyed Bharuch, Valsad and Vadodara districts.

In general, central team surveyed mainly those states and districts which were known to be goitre prone. But subsequent surveys in other states revealed that iodine deficiency is more widespread and occurs in all parts of the country.

To complete baseline survey of the districts of each state before the VII five year plan, it was planned to ask for co-operation from health departments of the states and also it was suggested that medical colleges can be entrusted with the survey work. In response, survey work was assigned to the Department of Preventive and Social Medicine of four Medical Colleges of Gujarat.

Goitre survey by the teams of Department of Preventive and Social Medicine were conducted as per guidelines provided for sampling and goitre gradation by DGHS Delhi.

GUIDE LINES FOR GOITRE SURVEY

SAMPLES

The Goitre survey is conducted on a random sampling basis. For the purpose of planning the survey, samples are collected as follows.

1. Five percent of all category of school children, both boys and girls in equal proportion, among all the schools in each block (taluka) of the district.
2. One percent of the village population - all ages and both sexes in each block (taluka) of the district.

TECHNIQUE OF EXAMINATION

From the clinical point of view the diagnosis of goitre is based entirely on inspection and palpalation of the neck. The position taken by the examiner in relation to the person being examined is a matter of personal choice. Some workers face the subject and usually palpate the isthmus and lobes with two thumbs, the fingers of both hand being spread around the lateral side of the neck. Other workers stand at one side of the subject, the side depending on whether tney are right handed or left handed. The palpation is done with first or first and second fingers. The examiner should be positioned so that his eyes are approximately at the level of the subject's neck. This means that in case of young children the examiner must be seated. When assessing the visibility of an enlarged gland it is important that the subject keeps the head steady so that the eyes and the external aural meatus are on one plane.

To assist in palpation, it is preferred to depress the subject's chin to relax the neck muscles. Initially, the isthmus should be located and then the thumbs or fingers should move laterally to identify the lobes and assess their size.

In people with short neck, a part or whole of the thyroid gland may be hidden by the sternum, this occasionally makes the diagnosis difficult.

Nodules should be noted and recorded separately

CLASSIFICATION OF GOITRE

Most classifications distinguish between the different grades of goitre and broadly between visible and palpable goitres and record the presence or absence of nodules. Visible goitres, as a rule

indicate a moderate to severe deficiency of iodine of relatively long duration and thus are more common among older people. Their presence in children however, suggest a severe deficiency of iodine. Similarly, nodules are largely present in the areas of marked deficiency of iodine for a very long period. Palpable goitres have social significance in the assessment of control program of salt iodization.

The following method of classification is recommended for use of goitre surveys (Perez, 1960).

CLASS 0 The thyroid is not felt or detected as a thin, even layer of tissue across the trachea; the lateral lobes are detected as slight masses, the edges of which merge imperceptibly into the surrounding connective tissue. This is the normal state.

CLASS 1 The borders (often only the lower border) of the isthmus and of the lateral lobes can be distinctly delineated; the enlargement of the gland is definite, but the gland is not visible on swallowing except in thin individuals. Most of these glands will be readily visible when the head is thrown back and the neck fully extended, It has been estimated that glands of this size are from three to five times larger than normal.

CLASS 2a The gland visibly fills nearly the whole of the suprastersnal hollow except for the dimple above the sternum. There may be a thin line of demarcation between lateral borders of the enlarged isthmus and the medial edges of the sternomastoid muscles. Slight bulges may be discernible in the sternomastoid muscles, but the outline of the neck is not distorted to a generally convex shape.

CLASS 2b The enlarged isthmus fills the suprasternal hollow. The lobes produce permanent bulges within two sternomastoid muscles. Producing a definite convex curvature to the neck. The general effect is not disfiguring.

CLASS 3 The neck outline is markedly convex, and the tumour is disfiguring.

Nodules A separate category should be established for nodular goitres in each of the above classes. It is not desirable to place this category with other categories in numerical sequence.

A modification of the above classification (Stanbury et al, 1974) where the grading is slightly different, has also been used in various epidemiological surveys.

1. Gr. Oa : Thyroid gland not palpable or if palpable not larger than normal.
2. Gr. Ob : Gland distinctly palpable but not visible when head is in the normal or raised position, considered to be definitely larger than normal i.e. atleast as large as the distal phalanx of the subject's thumb.
3. Gr. I : Gland is easily palpable and visible with the head in either a normal or raised position. The presence of a discrete nodule qualifies a patient for inclusion in this grade.
4. Gr. II : Gland is easily visible with the head in a normal position.
5. Gr. III : Goitre visible at a distance.
6. Gr. IV : Monstrous Goitre.

Here identification of goitre of grade Ob may need some training and experience therefore, wherever survey is being conducted by less skilled persons, this classification is not recommended.

Criteria for endemicity of goitre (Stanbury et al, 1974)
Endemic goitre would be considered to exist.

(1) When more than 5 percent of an adolescent or pre-adolescent group have grade I goitre or

(2) When more than 30 percent are assigned to grade Ob or above.

This decision is further strengthened if a fair sample of this population shows the mean daily iodine excretion in urine as :

(1) less than 50 ug per 24 hours or

(2) less than 50 ug per gram of creatinine in randomly obtained samples.

2. DISTRICT REPORT OF GOITRE SURVEYS

Districtwise Survey Assignments

Sr. No.	District Survey	Officer Incharge	Year
1.	Bharuch	Central Team	1972
2.	Vadodara	-- do --	1986
3.	Valsad	-- do --	1987
4.	Ahmedabad	Dr. N J Talsania	1988
5.	Gandhinagar	-- do --	1988
6.	Mehsana	Dr. Pradeep Kumar	1991
7.	Surendranagar	Dr. G P Kartha	1991
8.	Kheda	Dr. D N Shah	1991
9.	Panchmahal	Dr. A U Shah	1989
10.	Jamnagar	Dr.A S Sobati	1989
11.	Rajkot	-- do --	1990
12.	Junagadh	Dr. R K Shrivastava	1990
13.	Kutchh	-- do --	1991
14.	Dang	Dr.V K Desai	1988
15.	Amreli	-- do --	1988
16.	Sabarkantha	-- do --	1988
17.	Surat	-- do --	1988
18.	Bhavnagar	-- do --	1992
19.	Banaskantha	-- do --	1992

[Source: Deptt. of Health and Family Welfare, Gujarat State]

Summary table showing goitre prevalence rate in different districts during village survey

Sr. No.	District	Population (1981)	Population examined	Prevalence rate (%)
1.	Ahmedabad	3875794	14,525	4.85
2.	Amreli	1079097	10,029	14.00
3.	Banaskantha	1667914	23,922	6.90
4.	Bharuch	1296451	14898	31.40
5.	Bhavnagar	1879340	29,736	4.20
6.	Dang	113664	2,711	44.40
7.	Gandhinagar	289088	2717	2.36
8.	Jamnagar	1393076	13,105	2.19
9.	Junagadh	2100709	21,222	3.1
10.	Kheda	3015027	24066	4.91
11.	Kutchh	1050161	13961	1.01
12.	Mehsana	2548787	22,486	3.47
13.	Panchmahal	2321689	15016	22.40
14.	Rajkot	2093094	21,698	5.62
15.	Sabarkantha	1502284	14615	25.80
16.	Surat	2493211	25258	22.70
17.	Surendranagar	1034185	8378	4.4
18	Valsad	1774136	Not stated	38.3

DISTRICTWISE DETAIL REPORTS OF GOITRE SURVEYS

[Goitre surveys have been conducted for 19 districts of Gujarat and their reports are presented here in alphabetical order. Similar report for Vadodara was not available - Editors]

1. AHMEDABAD DISTRICT

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Department of PSM, B J Medical College, Ahmedabad.

Ahmedabad district with 8,707 Sq Kms area is divided into 7 talukas. Ahmedabad city is the district headquarters. There are 683 villages in the district. Total population of the district is 38,75, 794 (1981 census).

A total of 11,607 school children and 14,525 village population was examined. Out of total school children and village population examined 2,290 (19.73%) and 704 (4.85%) had goitre respectively.

Talukawise goitre prevalence rate (table no. 1) shows that it insignificantly varied from 14.56% to 25.5% in school survey and 3.35% to 7.38% in village survey.

Table No.1

Goitre prevalence rate in village and school survey

	Taluka	Village Survey		School Survey	
		Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
1	City	1,141	7.27	1.044	14.56
2	Daskoi	2,925	7.38	2.091	25.50
3	Dholka	2,115	3.64	2.268	21.16
4	Viramgam	2,289	3.61	1.654	17.29
5	Dahegam	1,637	5.13	1.665	16.94
6	Sanand	1,987	4.03	1.179	20.44
7	Dhandhuka	2,421	3.35	1.706	18.52
Total		14,525	4.85	11.607	19.73

Table No.2 shows grade specific prevalence rate of goitre. Majority of school children had goitre of grade Ob (12.91%) followed

by Grade I (6.28%) and Grade II (0.54%). Majority of village population had goitre of grade Ob (3.69%) followed by grade I (1.06%) and grade II (0.1%).

Table No. 2

Grade specific goitre prevalence rate

Grade	Village Survey		School Survey	
	No. of Goitre cases	Prevalence rate (%)	No. of Goitre cases	Prevalence rate (%)
Ob	536	3.69	1,499	12.91
I	154	1.06	728	6.28
II	14	0.1	63	0.54
Total	704	4.85	2.290	19.73

There were no cases of grade III-IV goitre in school and village . Nodular goitre was found only during village survey and its rate was 0.04%.

The result of the study indicates that majority of school children have palpable goitre and 6.28% have grade I goitre. Therefore it is reasonable to conclude that endemic goitre is prevalent in a mild degree in preadolescent and adolescent group of population in Ahmedabad district.

2. AMRELI DISTRICT

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Government Medical College, Surat.

Amreli district is the smallest district of Saurashtra with total area of 6,760 Sq. Kms. and 10,79,097 population (census 1981). There are total 10 talukas and 595 villages in the district. Amreli is the district Headquarters.

A total of 12,247 school children and 10,029 village population from ten talukas of Amreli district were examined. Out of total school children and village population examined, 2093 (17.1%) and 1404 (14.0%) respectively had goitre.

Talukawise goitre prevalence rate (table no. 1) shows that it was

highest (22.0%) and lowest (8.6%) in Kodinar and Kukavav talukas respectively in village survey, and it was highest (35.9%) and lowest (11.2%) in Liliya and Jafrabad talukas respectively in school survey. Three taluka had less than 10%, six talukas had 10-20% and remaining one had more than 20% goitre prevalence rate in village survey.

Table No. 1

Goitre prevalence rate in village and school survey.

Taluka	Village Survey		School Survey	
	Population examined	**Prevalence rate (%)**	**Population examined**	**Prevalence rate (%)**
Lathi	880	18.9	1199	26.5
Liliya	608	16.4	759	35.9
Babra	865	18.3	1206	17.7
Khambha	445	8.9	504	17.0
Amreli	1180	10.8	1825	13.4
Dhari	994	10.5	1377	9.6
Kukavav	1315	8.6	1500	11.9
Kodinar	1454	22.0	1735	19.2
Jafrabad	737	16.6	401	11.2
Rajula	1551	9.6	1741	15.2
Total	10029	14.0	12247	17.1

Age specific goitre prevalence rate (table no. 2) shows that it was 2.6% in 0-6 years age group followed by increasing prevalence rate with increasing age, reaching peak prevalence in the 13-20 years age group and then shows a declining trend with increasing age in the goitre prevalence rate in the village survey. In school survey goitre prevalence rate was highest in the 13-20 years age group.

Table No.2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	School survey
0 - 6	2.6	4.9
6 - 13	16.8	16.9
13 - 20	21.4	23.2
20 - 30	21.1	–
30 - 40	16.4	–
> 40	6.4	–
Total	14.0	17.1

Table No.3 shows grade specific goitre prevalence rate. Majority of school children had goitre grade Ob (14.2%) followed by grade I (2.8%), grade II 0.1% and grade III and IV 0.01%. Majority of village population had goitre grade Ob (11.1%) followed by grade I (2.6%) and grade II 0.3%.

Table No.3

Grade specific goitre prevalence rate (%)

Grade of goitre	Village survey	School survey
Ob	11.1	14.2
I	2.6	2.8
II	0.3	0.1
III & IV	–	0.01
Total	14.0	17.1

Nodular prevalence rate was 0.26% and prevalence of cretinism was 0.06% in village and school survey combined.

Epidemiologically Amreli district is not endemic for IDD. Higher prevalence of goitre in school children and population of Lathi and Liliya talukas may be due to fluorosis endemicity in this area which requires detailed epidemiological study.

3. BANASKANTHA DISTRICT

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Banaskantha is the northern most district of Gujarat state. North eastern hilly tribal belt of Gujarat state begins from Danta taluka of this district. On west it is bounded by Kutchh and in south it is bounded by Mehsana district. Total area of the district is 12072 Sq.Kms and is divided into 11 taluka with 1359 villages. Headquarters of the district is Palanpur. Total population is 1667914 (census 1981).

A total of 9,946 school children and 23922 village population from nine talukas were examined. Overall goitre prevalence rate in school survey was 9.6% and in village survey was 6.9%. (Table No.1)

In the village as well as school survey, overall goitre prevalence rate was highest in Danta taluka followed by Vadgam and Dhanera. Except Danta and Vadgam, goitre prevalence rate in all the surveyed taluka was less than 10%.

Age specific goitre prevalence rate is shown in Table No.2. In the under five children, goitre prevalence rate was 1.6%. A consistent increase in prevalence rate was seen with increasing age with peak prevalence in the 13-29 years age group in the village survey and 13-18 years age group in school survey. In the village survey a decline in prevalence rate was observed with increasing age after 18 years.

Grade specific goitre prevalence rate is shown in Table No.3. In village survey goitre grade I prevalence was 6.04%, grade II 0.84% and grade III 0.06%. In school survey goitre grade I prevalence was 8.9%, grade II 0.7% and grade III 0.01%.

Table No.1

Goitre prevalence rate in village and school survey

	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Deesa	2499	2.7	--	--
Vav	2614	3.9	--	--
Kankrej	3634	6.0	2338	8.1
Dhanera	2414	8.9	1590	9.8
Danta	2189	16.2	1139	20.0
Palanpur	3605	7.5	1417	6.3
Tharad	2208	4.9	424	7.7
Diyodar	--	--	--	--
Radhanpur	--	--	--	--
Vadgam	2459	10.2	2192	10.6
Santalpur	2300	3.2	846	2.6
	23922	6.9	9946	9.6

Overall age specific and grade specific goitre prevalence rate was higher in female than male population in village and school surveys.

Present survey was conducted by paramedical workers. They were trained to observe goitre grade I to III and record the same. For comparison with other districts if proportion of Ob grade is calculated, based on the values obtained in the adjacent district of Sabarkantha and added to grade I to III, overall prevalence rate comes to 23.2% in village and 22.3% in school survey. Then the epidemiological trend of goitre is similar to that of other districts.

Table No.2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	School survey
0 - 5	1.6	--
6 - 12	8.4	8.6
13 - 18	9.7	13.4
19 - 29	9.7	--
30 - 39	7.3	--
> 40	5.4	--
Total	6.9	9.6

Table No.3

Grade specific goitre prevalence rate (%)

Goitre grade	Village survey	School survey
I	6.04	8.9
II	0.84	0.7
III	0.06	0.01
Total	6.94	9.61

4. BHARUCH DISTRICT

NGCP CENTRAL TEAM

Bharuch district with total 9038 Sq.Km. area is located in South Gujarat. To its north lies Vadodara district and on south is the Surat district. Western boundary is the seashore area and eastern boundary is a hilly tribal area. District is divided into 11 talukas and 1217 villages. Total district population is 12,96,451 (1981). Bharuch is the district headquarters.

Overall goitre prevalence rate was 31.4 % in village survey and 33.8 % in urban survey. In village survey, goitre prevalence rate was

highest (65.0 %) in Dadiapada taluka followed by Sugbara taluka (55.5 %). In remaining talukas, 2 had prevalence of goitre more than 30 %, 5 had between 20-30 % and 2 had 17.0 % and 19.5 % prevalence rate. Nandod city had higher prevalence (39.8 %) than Bharuch (17.0 %) (Table No.1).

Table No. 1

Goitre prevalence rate in village and urban survey

	Village Survey		Urban Survey	
	Population examined	**Prevalence rate (%)**	**Population examined**	**Prevalence rate (%)**
Bharuch	1591	17.0	728	17.0
Nandod	1572	45.0	2042	39.8
Dadiapada	1659	65.0		
Sagbara	942	55.5		
Vagra	832	37.7		
Jhagadia	2254	22.8		
Ankleshwar	2131	19.5		
Hansot	2248	23.7		
Valia	1746	23.7		
Amod	1973	22.8		
Jambusar	2040	22.5		
Total	14898	31.4	2770	33.8

Age and sex specific goitre prevalence rate (table no 2) shows that overall goitre prevalence rate was 32.0 % in females and 30.9 % in males. In the total population, goitre prevalence rate was lowest (4.6 %) in the under four year age group followed by a consistent increase with increasing age till peak prevalence in 10-14 year age group which is then followed by a consistent decline with increasing age.

Table No. 2
Age specific goitre prevalence rate (%) in village survey

Age (yrs.)	Male	Female	Total
0-4	3.1	5.4	4.6
5-9	26.8	26.0	26.5
10-14	38.0	38.0	38.0
15-19	32.0	38.5	34.5
≥ 20	14.6	25.6	20.6
TOTAL	30.9	32.0	31.4

Peak prevalence of goitre (38.0 %) was seen in male as well as female in 10-14 yrs. age and in more than 20 years age group prevalence of goitre was 14.6 % in male and 25.6 % in female population.

Table No. 3 shows grade specific goitre prevalence rate in urban and rural areas. Goitre grade 1 was present in 26.4 % in urban and 24.4 % in rural area, 2a was present in 6.8 % in urban and 6.3 % in rural populations, while grade 3 was seen in 0.02 % urban and 0.1 % in rural population.

Table no. 3
Grade specific goitre prevalence rate (%)

Goitre	Urban	Rural
1	26.4	24.4
2a	6.8	6.3
2b	0.4	0.6
3	0.2	0.1
TOTAL	33.8	31.4

Goitre prevalence rate was higher in talukas towards the hilly areas compared to those towards the seashore. Bharuch district is endemic for goitre.

5. BHAVNAGAR DISTRICT

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District Bhavnagar is located in south east part of Saurashtra. Eastern boundary of the district has Bay of Khambhat. Districts of Amreli and Rajkot share the western boundary and Surendranagar and Ahmedabad share the northern border. Total area of the district is 11,159 Sq.Kms. District is divided into twelve talukas with 881 villages. Total population of the district is 18,79,340 (1981 Census). Bhavnagar is its district Headquarters.

A total of 21,650 school children and 29,736 village population from twelve talukas were examined. Overall goitre prevalence rate was 4.2% in village survey and 6.9% in school survey. In village survey all the talukas had goitre prevalence rate of less than 10% while in school survey goitre prevalence rate was 10.2% in Mahuva. 7-10% in five talukas, 5-7% in three talukas and less than 5% in remaining talukas.(Table No.1).

Table No.2 shows age specific goitre prevalence rate in village and school survey. In the underfive children, goitre prevalence rate was 1.1%.Consistent increase in goitre prevalence rate with increasing age with peak prevalence in 13-19 years was observed in village survey. This was then followed by a consistent decline in prevalence rate with increasing age. In the school survey prevalence rate was higher in 13-18 years age group than the younger age group.

Grade specific goitre prevalence rate is shown in Table No.3. In village survey grade I is 3.8%, Grade II 0.3% and grade III and IV 0.1%. In school survey goitre grade I is 6.6%,grade II 0.3% and no case of grade III and IV.

Overall age and grade specific goitre prevalence rate was higher in females than in males in both village and school survey.

Table No.1

Goitre prevalence rate in village and school survey.

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Bhavnagar	2931	5.8	1064	9.5
Shihor	1964	2.5	2296	5.2
Umarda	1067	4.0	2011	7.2
Palitana	4068	4.5	2174	9.6
Ganyadhar	1733	3.6	1782	5.6
Savarkudala	3338	4.3	2558	8.7
Mahuwa	4336	6.5	2581	10.2
Talaja	969	5.2	1302	7.0
Ghogha	1493	3.1	1248	4.2
Vallabhipur	1981	5.2	1290	5.3
Botad	2867	1.7	1330	4.3
Gadhada	2993	2.4	2014	3.2
Total	29736	4.2	21650	6.9

Present study was conducted by paramedical workers after thorough training. These workers were trained to identify only goitre I,II and III-IV. But to compare the overall rate with other studies, if a rate of grade Ob of a nearby district is applied to this survey it shows that overall goitre prevalence in village survey was 16.9% and school survey was 27.9%. Epidemiological trend of goitre is almost same as seen in other neighbouring districts.

Table No.2.

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	School survey
0 - 5	1.1	--
6 - 12	4.7	6.3
13 - 19	7.1	10.2
20 - 29	5.1	--
30 - 39	4.3	--
≥ 40	3.5	--
Total	4.2	6.9

Table No.3

Grade specific goitre prevalence rate (%)

Goitre grade	Village survey	School survey
Ob	—	6.6
I	3.8	0.3
II	0.3	---
III & IV	0.1	---
Total	4.2	6.9

6. DANG DISTRICT

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Dang is entirely a tribal district of Gujarat State with 1,764 Sq.Kms. area. The district is hilly and thickly forested. There are total 312 villages in the district. Total population is 1,13,664 as per 1981 census and thus it is the smallest district of the Gujarat State in terms of total population. District is not divided into talukas. Headquarters of the district is Ahwa.

A total of 1281 school children and 2711 village population from five PHC area and headquarter town were examined. Out of total school children and village population examined 864 (67.5%) and 1204 (44.4%) had goitre.

PHCwise goitre prevalence rate (table no. 1) shows that it was highest (52.8%) in Kalibel PHC and lowest (27.4%) in Ahwa in village survey, while in school survey most PHC areas had goitre prevalence rate more than 40%.

Table No. 1

Goitre prevalence in village and school survey.

PHC	Village Survey		School Survey	
	Total examined	Prevalence rate (%)	Total examined	Prevalence rate (%)
Sakarpatal	343	51.6		
Waghai	335	51.6		
Subir	462	39.8		
Shamgahan	478	46.7		
Kalibel	579	52.8		
Ahwa	514	27.4		
Total	2711	44.4	1281	67.5

Age specific goitre prevalence rate (table No. 2) shows an increasing trend with increasing age and peak prevalence in 13 - 19 years age group followed by a consistent decline with increasing age.

Table No.3. shows grade specific goitre prevalence rate in village and school survey. Majority of school children had goitre grade I (31.5%) followed by grade II (7.4%), grade III (0.1%) and grade IV (0.3%). In school children Ob grade was present in 28.2%. Majority of the village population had goitre of grade Ob (22.5%) followed by grade I (17.1%), grade II (4.2%), grade III (0.5%) and grade IV (0.1%).

Table No 2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	School survey
0 - 5	11.1	--
6 - 12	55.9	56.40
13 - 19	66.6	76.40
20 - 29	57.6	--
30 - 39	45.9	--
≥ 40	29.4	--
Total	44.4	67.5

Table No. 3

Grade specific goitre prevalence rate (%)

Goitre Grade	Village survey	School survey
Ob	22.5	28.2
I	17.1	31.5
II	4.2	7.4
III + IV	0.6	0.4
Total	44.4	67.5

In village survey 4.2% of the total goitre cases and in school survey 3.9% of the total goitre cases were nodular. Prevalence rate of cretinism (overall) was 0.9%.

Overall goitre prevalence, visible goitre prevalence and nodular goitre prevalence was higher in female than male population in village and school survey (table no. 4).

Table No. 4

Goitre prevalence rate (%) in male and female

Sex	Village survey	School survey
Male	35.4	62.6
Female	53.6	73.2
Total	44.4	67.5

Dang district shows highest prevalence rate in Gujarat state and needs urgent attention for IDD control activities.

7. GANDHINAGAR DISTRICT

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Gandhinagar is the smallest district of Gujarat state. State capital Gandhinagar is the headquarters of the district. Total area of Gandhinagar is 649 Sq.Kms with 79 villages. District is not divided into talukas. Total Population of the district is 2,89,088 (1981 census).

A total of 3,444 School children and 2,717 village population from Gandhinagar district were examined. Out of total school children and village population examined 451 (13.09%) and 64 (2.36%) respectively had goitre.

Table No.1 shows grade specific prevalence rate of goitre. Majority of school children had goitre of grade Ob (8.89%) followed by grade I (4.09%) and grade II (0.11%). Majority of village population had goitre of grade Ob (1.55%) followed by grade I (0.74%) and grade II (0.07%).

There were no cases of grade III, IV and nodular goitre in school as well as in village survey.

In Gandhinagar district, prevalence of Goitre of grade I was below 5% in preadolescent and adolescent age group. This suggests that goitre is not in endemic proportion and it is not a public health problem.

Table No.1

Grade specific goitre prevalence rate (%)

Goitre Grade	Village Survey		School Survey	
	No. of goitre cases	Prevalence rate (%)	No. of goitre cases	Prevalence rate (%)
Ob	42	1.55	306	8.89
Gr. I	20	0.74	141	4.09
Gr. II	2	0.07	4	0.11
Total	64	2.36	451	13.09

8. JAMNAGAR DISTRICT

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Jamnagar district with total 14,125 Sq.Kms area is one of the six districts of Saurastra. There are total 10 talukas and 701 villages in the district. Total population is 13,93,076 (1981 census). Headquarters of the district is Jamnagar.

A total of 9904 school children and 13,105 village population from ten talukas of Jamnagar district were examined. Out of total school children and village population examined, 453 (4.57%) and 288 (2.19%) respectively had goitre.

Talukawise distribution of goitre prevalence (table no. 1) showed that it was highest in village survey (6.41%) and school survey (9.44%) in Dhrol taluka. Prevalence rate was lowest in village survey (0.84%) and school survey (1.62%) in Kalyanpur taluka. In village survey, five talukas had prevelence <2% and two talukas had >5% goitre prevalence rate while remaining three talukas had prevalence rate between 2-5%.

In school survey only one taluka had prevalence rate <2% while three talukas had >5%.

Table No.1

Goitre prevalence rate in village and school survey

	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Jamnagar	4877	1.8	1771	6.5
Bhanwad	818	5.0	755	6.3
Dhrol	590	6.4	625	9.4
Jamjodhpur	983	2.1	939	4.5
Jodiya	818	1.9	806	4.4
Kalawad	1266	2.5	1331	3.8
Kalyanpur	1431	0.8	984	1.6
Khambhalia	1056	1.2	1225	2.2
Lalpur	877	2.4	881	4.5
Okhamandal (Dwarka)	389	1.0	581	2.9
Total	13105	2.19	9904	4.57

Age specific goitre prevalence rate is shown in table No.2. Age specific goitre prevalence rate shows an increasing trend with increasing age with peak prevalence in 6-14 years age group. After that a decline in prevalence rate with increasing age is observed. In school children the prevalence of goitre was higher in the 10-14 years age group than in the younger age group.

Overall, age specific and grade specific prevalence rate was higher in females than in males in both the village and school surveys.

Table No. 2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	
	Male	Female
0 - 5	2.5	3.4
6 - 14	3.9	4.4
15 - 24	1.5	3.6
25 - 34	---	1.4
35 - 44	0.2	2.0
45 - 54	---	2.0
≥ 55	---	0.5

Table No.3 shows grade specific prevalence rate in the village and school survey. Majority of cases in school children were of grade Ob (5.15%) followed by grade I (0.07%). Majority of cases in village population were also of goitre grade Ob (1.93%) followed by grade I (0.19%) and grade II (0.07%).

Table No.3

Grade specific goitre prevalence rate (%)

Goitre Grade	Village Survey		School Survey	
	No. of goitre cases	Prevalence Rate (%)	No. of goitre cases	Prevalence Rate (%)
Ob	253	1.93	446	4.50
I	25	0.19	7	0.07
II	10	0.07	---	---
Total	288	2.19	453	4.57

Nodular goitre prevalence rate was 0.017% in village and school population combined.

9. JUNAGADH DISTRICT

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Junagadh district with 10,607 Sq.Kms. area is located in the western part of the Gujarat state and is divided into 15 talukas, covering hilly, plain and coastal areas. There are 1069 villages in the district. Total population of the district is 21,00,709 (1981 census). Headquarters of the district is Junagadh city.

A total of 19,817 school children and 21,222 village population from fifteen talukas of Junagadh district were examined. Out of total school children and village population 1209 (6.1%) and 665 (3.1%) respectively had goitre.

Talukawise goitre prevalence rate (table no. 1) shows that it was highest (13.0%) in Talala and lowest (0.1%) in Porbandar and Veraval talukas in the village survey. It was highest (14.4%) in Keshod and lowest (0.7%) in Kutiyana talukas in the school survey.

Age specific goitre prevalence rate (table no. 2) shows an increase in goitre prevalence rate with increasing age in village survey with peak prevalence in the 6-14 years age group, then with increasing age a declince in goitre prevalence rate was observed. In school survey goitre prevalence rate was 7.0% in 6-14 years age group.

Table No 3 shows grade specific goitre prevalence rate in school and village surveys. Majority of the school children had goitre of grade Ob (5.4%) followed by gradeI (0.7%) and grade II (0.01%). Majority of the village population had goitre of grade Ob (2.6%) followed by grade I (0.5%), grade II (0.02%) and grade III (0.02%). There was no case of grade III goitre in school survey.

Overall goitre prevalence rate and visible goitre prevalence rate was higher in female than male population in school as well as in village survey.

Table No. 1

Goitre prevalence rate in village and school survey

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Talala	1194	13.0	929	10.2
Junagadh	2353	8.6	1934	8.5
Bhesan	844	7.1	806	11.2
Manavadar	1290	5.8	1289	9.5
Vanthali	1414	5.7	1230	10.5
Mendarda	649	5.6	955	10.4
Keshod	1288	5.3	1275	14.4
Visavdar	1264	2.3	1194	3.9
Malia	1340	1.9	1093	2.2
Mangrol	1281	0.8	1267	2.1
Ranavav	1426	0.5	787	2.2
Kutiyana	793	0.4	817	0.7
Una	2341	0.3	2038	5.0
Porbandar	1663	0.1	2094	1.1
Veraval	2082	0.1	2109	4.4
Total	21222	3.1	19817	6.1

In Talala taluka in Siddi (Negroid) population goitre prevalence rate was 4.2% which was significantly lower (X^2 = 8.89, df = 1, $p<0.01$) than the other population living in the same village (9.6%).

As the prevalence rates in community and school surveys were 3.1% and 6.1% respectively, Junagadh district is not an endemic area for IDD.

Table No. 2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	School survey
0 - 5	1.2	—
6 - 14	6.2	7.0
15 - 24	4.8	4.9
25 - 34	2.2	—
35 - 44	1.6	—
45 - 54	0.8	—
> 55	0.3	—
Total	3.1	6.1

Table No. 3

Grade specific goitre prevalence rate (%)

Goitre Grade	Village survey	School survey
Ob	2.6	5.4
I	0.5	0.7
II	0.02	0.01
III	0.02	—
Total	3.14	6.11

10. KHEDA DISTRICT

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Kheda with an area of 7,194 Sq.Kms is situated in Central Gujarat and is divided into 10 talukas and 965 villages. Total population of the district is 30,15,027 (1981 census). Headquarters of the district is Kheda.

A total of 22,036 school children and 24,066 village population from ten talukas of Kheda district were examined. Out of total school children and village population examined, 1432 (6.5%) 1183 (4.9%) respectively had goitre.

Talukawise goitre prevalence rate (table no. 1) shows that it was highest (10.01%) in Matar taluka and lowest (1.61%) in Borsad taluka in village survey. In school survey prevalence rate was highest (10.51%) in Borsad taluka and lowest (2.64%) in Mehmdabad taluka.

Table No. 1

Goitre prevalence rate in village and school survey

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Mehmdabad	2036	2.3	1552	2.6
Nadiad	1632	7.9	2088	8.8
Anand	5321	5.0	2970	6.0
Petlad	1448	7.5	2141	8.2
Borsad	3238	1.6	2493	10.5
Khambhat	4327	8.2	1480	5.0
Mator	753	10.0	2056	6.7
Kapadvanj	3591	2.1	1655	3.9
Balasinor	1083	3.6	3314	5.4
Thasra	637	3.4	2467	5.5
Total	24066	4.9	22036	6.5

Age specific goitre prevalence rate in village and school surveys (table no. 2) shows a consistent increasing trend with increasing age with peak prevalence in 13 - 18 years age group in village and school survey.

Table No. 2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	School survey
0 - 5	0.3	---
6 - 12	2.8	6.2
13 - 18	7.1	8.8
≥ 19	5.9	---
Total	4.9	6.5

Grade specific goitre prevalence rate in village and school survey is shown in table no 3. Majority of the school children had goitre of grade 1 (6.34%). Majority of the village population also had goitre of grade 1 (4.7%) followed by grade 2a (0.2%). There was no case of goitre of grade 2b and 3 in village and school survey.

Table No. 3

Grade specific goitre prevalence rate (%)

Goitre grade	Village survey	School survey
1	4.7	6.34
2a	0.2	0.15
2b	---	---
3	---	---
Total	4.9	6.5

No case of nodular goitre was seen in village as well as school survey. Kheda district which is entirely a plain zone, has very low goitre prevalence rate and is not endemic for IDD

11. KUTCHH DISTRICT

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Kutchh is the State's biggest district with total 45,652 Sq.Kms area and is most sparsely populated district with total population of 10,50,161 (1981 census) in Gujarat State. Over half of the district is desert and marshland. The district is devided into 9 talukas and have 905 villages. Headquarters of the district is Bhuj.

10,357 school children and 13,961 village population from nine talukas of Kutchh district were examined. Out of total school children and village population examined 564 (5.5%) and 140 (10.0%) respectively had goitre.

Talukawise goitre prevalence rates (table no. 1) showed that highest goitre prevalence rates in village survey (3.1%) and school survey (10.0%) in Lakhpat taluka. Three talukas had prevalence rates less than 1% , four talukas had nearly 1% and two talukas had more than 2% (village survey). In the school survey four taluka had prevalence less than 5.0%, three talukas had between 5-7% and two talukas had between 9-10%

Age specific goitre prevalence rate in village and school survey (table no. 2) shows an increasing trend with increasing age with peak prevalence in the 6-14 years age group in village survey followed by a declining trend in prevalence rate with increasing age. In school survey goitre prevalence rate was higher in 10-14 years age group compared to 5-9 years age group.

Table No.3 shows grade specific prevalence rate. Maximum number of school children had goitre of grade Ob (5.14%) followed by grade I (0.29%) and grade II (0.02%). Majority of the village population had goitre of grade Ob (0.82%) followed by grade I (0.14%), grade II (0.04%) and grade III (0.01%).

Table No. 1

Goitre prevalence rate in village and school survey

	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Lakhpat	482	3.1	566	10.0
Abdasa	825	2.3	1125	9.6
Nakhatrana	2089	1.3	867	7.0
Mundra	845	1.0	1083	5.8
Anjar	2561	1.0	1463	5.1
Bhachau	1304	1.0	1556	4.9
Rapar	1409	0.9	660	3.4
Bhuj	2824	0.4	1256	3.4
Mandvi	1662	0.3	1781	5.4
	13961	1.0	10357	5.5

Table No. 2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	
	Male	Female
0 - 5	----	0.8
6 - 14	1.4	1.7
15 - 24	0.5	2.1
25 - 34	0.3	1.7
35 - 44	---	1.5
45 - 54	---	1.0
≥ 55	0.1	1.0

Table No.3

Grade specific goitre prevalence rate

Goitre Grade	Village Survey		School Survey	
	No. of goitre cases	Prevalence rate (%)	No. of goitre cases	Prevalence rate (%)
Ob	114	0.82	532	5.15
I	19	0.14	30	0.29
II	6	0.04	2	0.02
III	1	0.01	---	---
Total	140	1.01	564	5.46

Overall goitre prevalence and visible goitre prevalence rate was higher in females than males in all age groups. One case of feeble mindedness and one case of stunted growth was also recorded during survey.

12. MEHSANA DISTRICT

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Mehsana district is located in North Gujarat with 9027 Sq Kms area. There are total 11 talukas and 1084 villages in the district. Total population of the district is 25,48,787 (1981 census). Headquarters of the district is Mehsana.

A total of 19589 school children and 22,486 village population from eleven talukas of Mehsana district were examined.

Out of total school children and village population examined, 1466 (7.5%) and 780 (3.5%) respectively had goitre. Talukawise goitre prevalence rate in village and school survey (table no. 1) shows that it was highest in Sidhpur taluka (7.1%) and lowest in Visnagar taluka (1.1%) in village survey. Prevalence rate was highest (10.3%) in Harij taluka and lowest (3.9%) in Mehsana and Kalol talukas. Three talukas had prevalence less than 2.0 %, three had between 2-4% and four had between 4-6% in village survey.

Table No. 1

Goitre prevalence rate in village and school survey.

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Mehsana	2568	1.7	1670	3.9
Kalol	1654	1.7	1492	3.9
Kadi	2513	3.5	1925	8.9
Vijapur	3870	3.0	2855	9.1
Visnagar	1550	1.4	1543	6.7
Sami	1312	4.1	890	8.2
Harij	644	4.8	507	10.3
Chanasma	1937	4.1	2339	10.1
Patan	2270	5.1	2145	6.7
Sidhpur	2018	7.1	2247	5.9
Kheralu	2150	2.6	1976	8.8
Total	22486	3.5	19589	7.5

Age specific goitre prevalence rate (table no. 2) shows that it was 0.9% in 4 years age group followed by peak prevalence in 5-14 years. Then a declining trend with increasing age was observed in village survey. In school survey prevalence rate showed an increasing trend with increasing age with highest rate (8.4%) in 15-24 years age group.

Table No.3 shows grade specific goitre prevalence rate in village and school survey. Majority of school children had goitre of grade Ob (6.8%) followed by grade I (0.7%). Majority of village population had goitre of grade Ob (3.2%) followed by grade I (0.3%).

Overall and grade I goitre prevalence rate was higher in females than in males. Overall prevalence rate of cretinism was 0.03%. Application of Stanbury's criteria proves this district to be non-endemic.

Table No. 2

Age specific goitre prevalence rate

Age (Yrs.)	Village survey	School survey
0 - 4	0.9	--
5 - 7	5.5	7.1
8 - 14	5.5	7.5
15 - 24	5.1	8.4
25 - 44	2.6	--
> 44	1.5	--
Total	3.5	7.5

Table No.3

Age specific goitre prevalence rate (%)

Goitre grade	Village survey	School survey
Ob	3.2	6.8
I	0.3	0.7
II, III & IV	---	---
Total	3.5	7.5

Overall and grade I goitre prevalence rate was higher in females than in males. Overall prevalence rate of cretinism was 0.03%. Application of Stanbury's criteria proves this district to be non-endemic.

13. PANCHMAHAL DISTRICT

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Panchmahal district with total 8,866 Sq Km area is the eastern most district of Gujarat state. The district has a large tribal population and an eastern hilly zone. The district is divided into 11 talukas. Total population of the district is 23,21,689 (1981 census). Headquarters of the district is Godhra.

A total of 6,661 school children and 15,016 village population was examined. Out of total school children and village population examined, 1,167 (17.52%) and 3,365 (22.4%) respectively had goitre.

Talukawise goitre prevalence rate (table no. 1) shows that it was highest in Jambughoda (32.7%) and lowest in Lunawada (11.4%) talukas in the village survey. In the school survey, prevalence rate was highest in Shehra (29.2%) and lowest (6.7%) in DevgadhBaria taluka. Two talukas had prevalence more than 30%, five talukas had between 20-30% and remaining talukas had less than 20% goitre prevalence rate.

Table No. 1

Goitre prevalence rate in village and school survey

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Godhra	879	29.2	162	27.7
Kalol	404	11.8	1162	24.7
Halol	959	31.7	225	22.6
Shehra	1180	22.0	317	29.0
Lunawoda	1576	11.4	702	10.9
Santrampur	2552	18.3	950	17.8
Jhalod	2049	22.7	1015	18.3
Dahod	1627	29.8	351	8.5
Limkheda	1572	19.1	657	17.3
DevgadhBaria	1558	24.3	1011	6.7
Jambughoda	660	32.7	109	22.9
Total	15016	22.4	6661	17.5

Age specific goitre prevalence rate (table no. 2) shows an increasing trend with increasing age and peak prevalence in the 14-21 years age group, followed by a consistent decline with increasing age.

Table No.2

Age specific goitre prevalence rate (%)

Age (Yrs.)	Village survey	School survey
0 - 6	0.69	---
6 - 24	24.77	16.44
14 - 21	32.53	20.31
> 21	23.51	---
Total	22.41	17.52

Grade specific goitre prevalence rate is shown in Table No. 3. Majority of school children had goitre of grade I (14.8%), followed by grade 2a (2.52%), grade 2b (0.17%) and grade 3 (0.03%). Majority of the village population had goitre of grade 1(17.74%) followed by grade 2a (3.90%), grade 2b (0.67%) and grade 3(0.09%).

Table No.3

Grade specific goitre prevalence rate (%)

Goitre grade	Village survey	School survey
1	17.74	14.8
2a	3.90	2.52
2b	0.67	0.17
3	0.09	0.03
Total	22.40	17.52

Overall goitre prevalence rate and prevalence rate of higher grade of goitre was higher in females than in males in village and school population. The survey of Panchmahal district indicates moderate endemicity of IDD.

14. RAJKOT DISTRICT

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Rajkot district with an area of 11203 sq. kms. has a population

of 2093094 (1981 census). It has 13 talukas and 854 villages with Rajkot as its headquarters. Out of total school children (16295) and village population (21698) examined, 1368 (8.4%) and 1220 (5.6%) respectively had goitre.

Table No. 1
Goitre Prevalence rate in Village and School Survey.

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Rajkot	6019	5.8	5079	8.2
Kotdasangani	539	9.6	456	12.5
Gondal	2222	9.9	1410	8.7
Jetpur	1750	4.8	1100	7.3
Dhoraji	1569	3.4	865	7.3
Upleta	1711	3.6	620	6.3
Jamkandorna	650	3.5	555	7.7
Mahal Lodhika	390	9.2	339	13.3
Paddhari	705	9.2	671	8.9
Morvi	2500	4.5	1621	9.2
Maliya	648	2.2	346	5.2
Wankaner	1306	5.0	842	7.6
Jasdan	1698	4.4	1591	6.2
Total	21698	5.6	16295	8.4

Talukawise goitre prevalence rate (table 1) shows that it varied between 2.2% and 9.9% in village and between 5.2% and 13.3% in school survey.

Age specific goitre prevalence rate (table no. 2) shows that it was 0.3% in the under 5 years age group followed by peak prevalence (12.0%) in 6-14 years age group which was followed by a declining trend with increasing age (village survey). In the school survey prevalence rate was high (10.1%) in 15-24 years and the

prevalence rate for goitre was significantly high (9.5%) in girls than boys (7.4%) (X^2=22.5; df=1, p<0.01).

Grade specific goitre prevalence rate (table no. 3) shows that majority of the population in village and school survey had Ob grade goitre (4.4% and 6.7% respectively).

No other form of IDD (except one case of feeble mindedness) was seen in the survey. Epidemiologically too, this district does not seem to be endemic for goitre and other IDD.

Table No.2

Age specific goitre prevalence rate (%)

Age (years)	Village survey	School survey
0 - 15	0.3	—
6 - 14	12.0	5.7
15 - 24	8.7	10.1
25 - 34	3.2	—
35 - 44	3.1	—
45 - 54	1.7	—
≥ 55	0.7	
Total	5.6	8.4

Table No.3

Grade specific goitre prevalence rate (%)

Grade of goitre	Village survey	School survey
Ob	4.4	6.7
I	1.0	1.6
II	0.2	0.1
III & IV	0.03	—
Total	5.6	8.4

15. SABARKANTHA DISTRICT

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Sabarkantha district with 7,390 Sq. Kms area is situated in North Gujarat and is divided into 10 talukas. North eastern boundry of the district is a hilly tribal area. There are about 1,500 villages in the district with total population of 15,02,284 (1981 census). Headquarters of the district is Himmatnagar.

A total of 13,900 school children and 14,615 village population from ten talukas of Sabarkantha district were examined. Out of total school children and village population examined, 6311 (45.4%) and 3767 (25.8%) respectively had goitre.

Talukawise goitre prevalence rate (table no. 1) shows that in village survey it was highest (43.3%) in Malpur taluka and lowest (8.4%) in Prantij taluka. Four talukas situated in north-eastern hilly tribal zone had more than 30% goitre prevalence rate. In ramaining talukas except Prantij goitre prevalence rate was between 20-29%. In school survey it was highest (74.6%) in Vijaynagar taluka and lowest (16.2%) in Prantij taluka.

Age specific goitre prevalence rate (table no. 2) shows an increasing trend with increasing age with peak prevalence in 13-20 years age group followed by a consistent decline with increasing age.

Table No.1

Goitre prevalence rate in village and school survey

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Khedbrahma	1230	41.6	743	68.5
Vijaynagar	765	41.8	669	74.6
Idar	2293	20.0	2047	56.3
Bhiloda	1586	22.1	1755	37.4
Himmatnagar	1569	22.1	1760	44.7
Meghraj	952	32.8	1124	58.0
Modasa	1687	21.6	1628	40.8
Malpur	726	45.3	819	71.4
Bayad	1903	20.3	1472	34.1
Prantij	1904	8.4	1883	16.2
Total	14615	25.8	13900	45.4

Table No. 2.

Age specific goitre prevalence rate (%)

Age (yrs.)	Village survey	School survey
0 - 6	8.8	---
6 - 13	33.1	43.3
13 - 20	37.9	49.4
20 - 30	30.9	---
30 - 40	28.1	---
> 40	12.3	---
Total	25.8	45.4

Grade specific goitre prevalence rate is shown in table No.3. Majority of school children had goitre of grade Ob (32.7%) followed by grade I (11.6%), grade II (1.1%) and grade III (0.1%). Majority of the village population had goitre of grade Ob (18.3%) followed by grade I (6.3%), grade II (1.1%), grade III (0.1%) and grade IV (0.03%).

Table No.3

Grade specific goitre prevalence

Grade of goitre	Village survey	School survey
Ob	18.3	32.7
I	6.3	11.6
II	1.1	1.1
III	0.1	0.01
IV	0.03	—
Total	25.8	45.4

Nodular goitre prevalence rate in the total population examined in school and village survey was 2.4% and rate of cretinism in this population was 0.5%. Overall goitre prevalence, visible goitre prevalence and nodular goitre prevalence rates all were was higher in female than male population of village and school survey.

This baseline survey of Sabarkantha district indicates moderate endemicity of IDD and comparatively with a more severe problem in the talukas on the north eastern border of the district.

16. SURAT DISTRICT

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Surat district is situated in south Gujarat. Total area of the district is 7,657 Sq. Kms and is bounded in the west by Arabian sea, north by Bharuch district, east by hilly terrain and south by Bulsar and Dang districts. There are total 13 talukas and 1280 villages in the district. Total population of the district is 24,93,211.(1981 census). Surat city is the Headquarters of the district.

A total of 19,747 school children and 25,258 village population of thirteen talukas and nine talukas of Surat district respectively were

examined.

Out of total school children and village population examined, 4384 (22.2%) and 5722 (22.7%) respectively had goitre.

Talukawise goitre prevalence rate (table no. 1) shows that it was highest (42.2%) in Vyara taluka and lowest (5.7%) in Choryasi taluka in village survey. Prevalence rate was highest (44.8%) in Mandvi taluka and lowest (9.7%) in Olpad taluka in school survey. One third talukas in village survey and 23.1% talukas in school survey had less than 10% goitre prevalence rate.

Table No. 1

Goitre prevalence rate in village and school survey.

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Nizar	3004	29.7	833	20.9
Songadh	2422	40.0	1802	39.2
Vyara	3477	42.2	3088	31.1
Vcchal	—	—	590	42.9
Valod	—	—	772	41.9
Mahuva	—	—	1718	9.9
Mandvi	3128	21.4	1206	44.8
Bardoli	2526	23.5	1593	20.8
Mangrol	3014	18.0	1825	10.9
Palsana	1454	7.6	895	15.5
Olpad	2247	6.9	1432	9.7
Choryasi	3992	5.7	3241	9.9
Kamrej	—	—	1252	14.9
Total	25258	22.7	19747	22.2

Age specific goitre prevalence rate (table no. 2) shows that it was 2.6% in 0-6 years age group followed by an increasing trend

with increasing age, peak prevalence at 13-20 years age group and then a consistent decline with increasing age in village survey. In school children goitre prevalence rate was higher in the 13-20 years age group than in the younger age group.

Table No. 2
Age specific goitre prevalence rate (%)

Age (yrs.)	Village survey	School survey
0 - 6	2.6	---
6 - 13	29.3	18.0
13 - 20	35.6	28.4
20 - 30	34.3	---
30 - 40	24.8	---
$\geq$ 40	10.9	---
Total	22.7	22.2

Table No.3 shows grade specific goitre prevalence rate in village and school survey. Majority of the school children had goitre of grade Ob (16.9%), followed by grade I (4.4%), grade II (0.8%), grade III and IV (0.07%). Majority of the village population had goitre of grade Ob (16.9%) followed by grade I (4.7%), grade II (0.9%) and grade III and IV (0.2%).

Table No.3
Grade specific goitre prevalence (%)

Goitre grade	Village survey	School survey
Ob	16.9	16.9
I	4.7	4.4
II	0.9	0.8
III & IV	0.2	0.1
Total	22.7	22.2

Nodular goitre prevalence rate was 2.4% and prevalence of cretinism was 0.4%. Overall goitre prevalence, visible goitre

prevalence and nodular goitre prevalence rates all were higher i female than male population of both village and school survey.

Goitre endemicity in the eastern hilly talukas was sever followed by talukas of central zones and seashore area. Overal observations indicate endemicity of IDD in the district.

17. SURENDRANAGAR DISTRICT

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Surendranagar district with total 10,489 Sq.Kms area is the link between Kutchh and mainland. There are 661 villages and nine taluka in the district. Total population of the district is 10,34,185 (1981 census). Headquarters of the district is Surendranagar.

A total of 9451 school children and 8,378 village population were examined. Out of total school children and village population examined, 556 (5.88%) and village population 375 (4.48%) respectively had goitre.

Talukawise goitre prevalence rate (table no. 1) shows that it was highest (6.86%) and lowest (2.55%) in Lakhtar and Dhrangadra talukas respectively in the village survey. In the school survey it was above 8% in three taluka between 4-8% in four talukas and 3-4% in two talukas.

Age specific goitre prevalence rate (table no. 2) shows that it was lowest (0.59%) in years age group and highest (7.63%) in 15-19 years age group in village survey though no consistent trend of goitre prevalence rate was observed in village survey, rate was lower in the above 35 years age group.

Grade specific goitre prevalence rate is shown in Table No.3. Majority of school children had goitre of grade Ob (4.6%) followed by grade I (1.2%) and grade II (0.04%). Majority of the village population had goitre of grade Ob (3.2%) followed by grade I (1.0%), grade II (0.1%) and grade III (0.1%).

Table No. 1
Goitre prevalence rate in village and school survey

Taluka	Village Survey		School Survey	
	Population examined	Prevalence rate (%)	Population examined	Prevalence rate (%)
Muli	926	3.4	588	8.5
Chotila	887	4.0	856	8.6
Sayla	460	6.8	528	8.5
Limdi	597	3.8	519	3.4
Vadhwan	1167	3.8	1876	5.7
Dhrangadra	943	2.5	1866	3.8
Lakhtar	1297	6.9	1104	5.3
Halvad	927	5.7	923	6.9
Putdi	1174	6.6	1191	5.7
Total	8378	4.5	9451	5.8

Females showed higher prevalence of goitre in all age groups. One case of typical cretinism manifestation and two cases of hypothyroidism were detected during survey.

It can be concluded from the study that goitre problem is not an endemic one for this district and currently does not need any large scale intervention programme. As a substantial number of individuals were found having low grades of goitre (Ob) educational activities centred around use of iodised salt need to be encouraged.

Table No. 2

Age specific goitre prevalence rate (%)

Age Group	Village survey	School survey
0 - 4	0.5	-----
5 - 9	5.4	5.9
10 - 14	4.8	5.9
15 - 19	7.6	0.8
20 - 24	6.4	----
25 - 29	6.8	----
30 - 34	5.7	----
35 - 39	2.7	----
40 - 44	3.4	----
≥45	2.1	----
Total	4.5	5.8

Table No. 3

Grade specific goitre prevalence

Goitre grade	Village survey	School survey
Ob	3.2	4.6
I	1.0	1.2
II	0.2	0.04
III	0.1	----
IV	----	----
Total	4.5	5.8

18. VALSAD DISTRICT

NGCP TEAM

Valsad is the southern most district of Gujarat state with 5244 q.Km. area. Eastern border of the district has a hilly terrain and on ne western side is the seashore. This district is divided into 8 talukas nd 832 villages. Population of the district is 17,74,136 (1981 census). alsad is the district head-quarters.

Overall goitre prevalence rate was 38.3 % in the village survey nd 24.05 % in the urban survey. Goitre prevalence rate was highest Gandevi taluka (55.3%) followed by Navsari (53.5%) and harampur (41.48%), in the remaining talukas in two it was between 0-40 % in three it was between 20-30 % (table no. 1)

Table No.1

Goitre prevalence rate (%) in village and urban survey

Taluka	Village survey	Urban survey
Vansoda	34.1	
Dharampur	41.5	
Umargam	27.6	
Pardi	25.6	
Valsad	25.3	
Chikhli	32.4	
Gandevi	55.3	
Navsari	53.5	
Total	38.3	24.0

Age specific goitre prevalence rate (table no. 2) whows that it as 3.23 % in less than four years age group followed by a nsistently increasing trend with increasing age. In urban survey it as 12.3 % in 5 Years age group with two times higher prevalence in years and above age group.

Table No.2

Age specific goitre prevalence rate (%)

Age (yrs.)	Village survey	Urban survey
0-4	3.2	—
5-9	31.0	12.3
10-14	40.7	27.6
15-19	42.8	26.6
≥ 20	42.7	27.3
Total	38.3	24.0

Table No.3 shows grade specific goitre prevalence rate. In rura areas it was 25.4 % in grade 1, 11.1 % in grade 2a, 1.1 % in grade 2 and 0.2 % in grade 3. In urban area grade specific goitre prevalenc was 17.5 % grade 1, 7.3 % in grade 2a and 0.3 % in grade 2b and 0. % in grade 3.

Table No.3

Grade specific goitre prevalence rate (%)

Goitre grade	Urban	Rural
1	17.5	25.4
2a	7.3	11.6
2b	0.25	1.1
3	---	0.2
Total	24.0	38.3

Goitre prevalence rate is more than 40 % in more than one thir of talukas of the district, majority of the talukas with lowe prevalence are towards seashore.

3. OTHER EPIDEMIOLOGICAL STUDIES

IDD IN TRIBALS OF SURAT DISTRICT

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A preliminary study (Desai, 1980) in school children of Songadh taluka of Surat District revealed goitre prevalence rate of 40 %. The survey of Bharuch and Valsad districts by NGCP team also highlighted significantly higher prevalence of goitre in eastern hilly tribal area. With this background a detailed study of IDD was planned for hilly tribal talukas of Surat district in 1984.

A total population of 9454 from twenty villages under three primary health centres located in the eastern hilly zone of Surat district was examined. Urine samples and water samples were collected for iodine estimation.

RESULTS & DISCUSSION

Overall goitre prevalence rate was 34.8 %. It was significantly higher in females (43.7 %) than in male (24.7 %). Age specific goitre prevalence rate was lowest in under five group (8.2 %) followed by a six fold rise in 6-12 age group and peak prevalence in 13-19 years age group which was subsequently followed by a consistent decline in goitre prevalence rate with increasing age.

Perez et al (1967) have recommended that goitre prevalence rates be expressed for each sex separately. Such analysis in present study shows that goitre prevalence rate was higher in females than in males in each age group. The peak of goitre prevalence was earlier (6-12 years) in male than female (13-19 years). In females the peak continues in the next age group. Then there is a consistent decline in prevalence rate with increasing age and has a slower rate in females than that in males. In above 50 years age group 20 % of female had goitre and this prevalence was more than three times significantly higher than male of same age group.

Distribution of goitre cases according to grade is shown in table no. 2. Out of total cases, 68.9 % were palpable goitre, 24.9 % were grade I, 5.4 % were grade II, and 0.8 % grade III-IV. Thus visible (easily indentifiable) goitre was only 6.2%.

Table no. 3 shows prevalence of nodular goitre in the study

area. Nodular goitre indicates severity of IDD in an individual and endemicity in community. Nodular goitre prevalence rate was three times higher (1.01 %) in females than in males (0.31 %). There were no cases of nodular goitre in below five years age group which is then followed by a consistently increasing rate with increasing age . Overall nodular goitre prevalence rate was 0.7 %.

Urinary Iodine excretion reflects iodine nutrition of the body. The level below 50 ug/g creatinine indicates iodine deficiency. Total 183 urine samples were analysed for iodine excretion level. Overall mean excretion level was 133.53 +/- 80.50 ug/gcr. with 21.3 % samples having less than 50 ug/gcr level. Mean urniary iodine excretion level was significantly lower in males (109.3 +/- 81.4 ug/gcr) than in females (115.4 +/- 84.0 ug/gcr). Urine samples with less than 50 ug/gcr level were less in the below 20 years age group, followed by an increasing trend with increasing age except 20-29 years age group. Almost one fifth samples showing low iodine excretion level indicates endemicity of IDD in study area.

Goitre prevalence rate in relation to water iodine level shows an inverse relationship. A total of 8140 individuals were from the areas with less than 10 ppm iodine and had goitre prevalence rate of 36.0%, 404 individuals from the area with 11- 20 ppm iodine had 22.7 % prevalence while 910 individuals from 21-30 ppm water iodine area had 29.2 % goitre prevalence rate.

A total of 77 persons had health consequences due to iodine deficiency, commonest was feeble mind and stunted growth (18.2 %) followed by goitre defect and squint (16.7 %) deafmutism (15.6 %), cretinism (11.7 %) and hypothyroidism (2.6%)

Goitre defects such as stunted growth and cretinism were more frequent in females than in males, while hypothyroidism was seen only in females. Majority of the cases (81.8 %) were below 30 years age and no cretin was seen beyond that age. Forty three (55.8 %) persons had no goitre but associated health consequences were present. The study indicate a significant rate of goitre associated health consequences in the study area.

Amongst the tribal population (under study), goitre prevalence rate was significantly higher in a group consuming only locally grown food (34.6 %) than the others (30.4 %). Food is the major source of iodine and when it is grown in iodine deficient

environment it contains lower iodine, this puts the group consuming entirely locally grown food at a risk.

Study also reveals that when goitre prevalence rate is 30% or more then chances of cretin cases in the area increase. In all the villages with more than 50 % goitre prevalence rate, cretins were also seen.

Analysis of families with both parents and all children examined reveals that when both parents were goitrous, 35.1 % of their children had goitre, when only father had goitre 21.4 % children had goitre, when only mother had goitre 41.5 % children had goitre and when both the parents were normal 26.1 % children had goitre. Goitre prevalence rate in children with both the parents normal was significantly lower than children with both parents with goitre or only mother with goitre. This observation indicates role of common physical environment shared by family as well as importance of maternal environment on goitre prevalence in children.

This study confirms presence of IDD endemia and indicates need of control programme.

Table No.1

Age and sex specific goitre prevalence rate (%)

Age	Male		Female		Total	
	No. Examined	Prevalence rate (%)	No. Examined	Prevalence rate (%)	No. Examined	Prevalence rate (%)
0 - 5	889	7.7	912	8.7	1797	8.2
6 - 12	912	45.3	872	49.3	1784	47.2
13 - 19	479	43.8	523	72.2	1102	59.9
20 - 29	698	30.1	963	70.7	1661	53.6
30 - 39	523	20.3	562	50.4	1089	35.8
40 - 49	400	13.5	451	31.7	851	23.1
≥ 50	542	6.4	632	20.3	1174	13.9
Total	4439	24.7	5015	43.7	9454	34.8

Table No. 2

Percent distribution of goitre cases according to the grade

Grade	No.	(%)
Ob	2267	68.9
I	817	24.9
II	179	5.4
III + IV	27	0.8
Total	3290	100.0

Table No. 3

Agewise prevalence rate of nodular goitre cases.

Age (Years)	Population examined	Prevalence rate (%)
0-5	1797	----
6-12	1784	0.2
13-19	1102	0.7
20-29	1661	0.7
30-39	1085	1.1
40-49	851	1.3
≥ 50	1174	1.7
Total	9454	0.7

Table No. 4

Urinary inorganic iodine excretion (UII) in study area

UII Excretion (ug/gcr)	Samples	
	No.	(%)
0 - 50	39	21.3
51 - 100	66	36.1
101 - 150	33	18.0
151 - 200	10	5.5
201 - 250	13	7.1
251 - 300	22	12.0
Total	183	100.0

HEALTH PROFILE OF PREADOLESCENT AND ADOLESCENT GIRLS IN RELATION TO NATURAL IODINE ENVIRONMENT IN SURAT DISTRICT.

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Deficient intake of iodine, physiological changes of puberty pregnancy and lactation result in iodine deficiency. Continuation of iodine deficiency from preadolescent and adolescent phase will aggravate deficiency during pregnancy and lactation and result in serious irreversible manifestations of IDD in their offspring. These facts enroll them as vulnerable group for iodine deficient nutrition.

Present study aims at assessment of goitre and urinary iodine excretion profile in girls of preadolescent and adolescent age groups from regions with different level of natural iodine environment.

Material and Method

Present study was conducted in girls' schools of Surat, Bardoli, Ukai and Vyara. These four areas from Surat district topographically represent western seashore, plains and eastern hilly area. Water iodine levels indicating natural iodine environment in these four areas are shown in table no. 1.

Table No. 1

Sr. No	Area	Topography	Water iodine (mg/litre)
1.	Surat	Seashore	43.5 (> 30)
2.	Bardoli	Plains	27.0 (20-30)
3.	Ukai	Hilly area	15.0 (10-20)
4.	Vyara	- do -	5.4 (< 10)

Figures in parantheses indicate range of water iodine levels

Total 932 girls of 12-18 years age group were examined for their nutritional and goitre status. Their urine samples were analysed for urinary iodine excretion level by standard method.

Results and discussion

Prevalence of goitre among preadolescent and adolescent age

group in school children is a reliable indicator of the prevalence of goitre in a population. Present study was the first in Surat district on iodine deficiency and for preliminary assessment of the problem. Girls of 12-18 years being in a vulnerable age group were identified as study group.

Goitre was seen in girls of all the four areas (table no. 2). Prevalence rate showed significantly increasing trend from Surat to Vyara. It was 24.2% in Surat, 36.4% in Bardoli, 52.4% in Ukai and 58.7% in Vyara. Visible goitre prevalence rate was also significantly lowest in Surat and showed increasing trend from Surat to Vyara.

Mean urinary iodine excretion level was significantly highest in girls of Surat and lowest in girls of Ukai. A total of 10.8% girls of Surat, 39.4% girls of Bardoli, 65.9% girls of Ukai and 52.6% girls of Vyara had iodine 50 mg/gm. creatinine level (table no. 5).

Goitre prevalence rate and urinary iodine excretion pattern indicates a higher rate of iodine deficiency in Vyara and Ukai and lowest in Surat.

Physiological changes of menarche and menstruation are related with age. Median age of menarche was between 14.5-14.7 years in these four areas. Goitre prevalence rate and urinary iodine excretion level in study group was analysed according to age and menarche status.

Age specific goitre prevalence rate was 39.4% in 12-14 years, 46.0% in 14-16 years and 50.3% in 16-18 years age group. Thus consistent significant increase in goitre prevalence rate with increasing age was observed (table no. 3). Mean urinary iodine excretion level was significantly lower in 16-18 years age group than 12-14 years age group.(Table No. 5).

Overall goitre prevalence rate and visible goitre prevalence rate both were significantly higher in girls who had attained menarche than those who did not. Though this trend was seen in all four areas, difference in goitre prevalence rate in the group before menarche and that of after menarche was statistically significant only in Surat. Mean urinary iodine excretion level was significantly lower after menarche than before menarche (table no. 5).

No significant association between height, BMI and fatfold thickness and goitre prevalence rate was observed but significantly higher proportion of girls with other vitamins and mineral deficiency

had goitre than those without such nutritional deficiency.

Mean urinary iodine excretion level was higher 104.2 mg/g creatinine +/- 69.9 in girls without goitre than those with goitre Declining trend in mean urinary iodine level with increasing grade o goitre was also observed. Percentage of girls with 50 mg/g. creatinin iodine level was lowest 28.0% in those without goitre. Thi percentage showed increasing trend with increasing severity of goitr (table no. 5).

Present study highlights the existence of iodine deficienc manifestations in 12-18 years old girls in all four study areas wit significantly higher rate in eastern hilly area. It also indicates role o hormonal changes due to menarche in increasing the severity of IDI which is also reflected on age specific prevalence rate Anthropometric measurements are not affected by iodine deficienc but other clinical nutritional deficiencies show significant associatio to iodine deficiency. Clinical manifestation of iodine deficiency in th form of goitre reflects metabolic deficiency of iodine in the body i study group.

Table No. 2

Goitre prevalence rate in four areas.

Sr. no.	Area	Girls examined	Goitre grade				Prevalence rate (%)
			Ob	I	II	Total	
1.	Surat	297	47	25	--	72	24.2
2.	Bardoli	195	57	14	--	71	36.4
3.	Ukai	191	63	37	--	100	52.4
4.	Vyara	249	80	71	20	171	68.7
	Total	932	247	147	20	414	44.4

Value of Z test between :

(i) 1 and 2 ; Z= 2.87 - Significant
(ii) 1 and 3 ; Z= 6.41 - -do-
(iii) 1 and 4 ; Z= 11.57 - -do-

(iv) 2 and 3 ; Z= 3.2 - Significant (v) 2 and 4 ; Z= 7.1 - -do-
(vi) 3 and 4 ; Z= 3.5 - -do-

Table No. 3

Age specific goitre prevalence rate in girls of four study area.

Sr. No.	Age (yrs.)	Girls examined	Goitre grade			Total	Prevalence rate (%)
			Ob	I	II		
1.	12 - 14	377	86	35	4	125	39.4
2.	14 - 16	391	103	66	11	180	46.0
3.	16 - 18	195	50	43	5	98	50.3
4.	> 18	29	8	3	0	11	37.9
	Total	932	247	147	20	414	44.4

Value of Z test between

(i) 1 and 2 ; Z= 2.71 - Significan(iii) 1 and 4 ; Z= 0.32 - Not significant
(ii) 1 and 3 ; Z= 3.42 - -do-

Table No. 4-A

Goitre prevalence rate in relation to menarche status.

GOITRE GRADE

Sr.	Menarche	Girls examined	Goitre grade			Total	Prevalence rate (%) Gr.I & II
			Ob	I	II		
1.	Before	365	92	46	4	142	13.7
2.	After	567	155	107	16	272	19.8
	Total	932	247	147	20	414	17.9

Value of Z test between

1 and 2 ; Z= 2.8 - Significant.

Table No. 4-B

Goitre prevalence rate in relation to nutritional deficiency signs.

Sr.	Nutritional deficiency signs	Girls examined	Goitre cases	Prevalence rate (%)
1.	Present	193	107	55.4
2.	Absent	739	312	42.2
	Total	932	419	44.9

Value of Z test between

1 and 2 = 3.57 - Significant.

Table No. 5

Urinary iodine excretion with relation to certain parameters.

Parameters	No. of samples (N)	Urinary iodine excretion (mg/g cr)		% samples with <50 mg/g cr
		Mean	Standard deviation	
(1) Area				
(i) Surat	92	139.93	70.06	10.86
(ii) Bardoli	76	90.79	68.92	39.40
(iii) Ukai	79	56.65	78.79	65.91
(iv) Vyara	57	62.72	50.68	52.63

Table 5 contd....

Table 5 contd....

Parameters	No. of samples (N)	Urinary iodine excretion (mg/g cr)		% samples with <50 mg/g cr
		Mean	Standard deviation	
(2) Age (yrs.)				
(i) 12-14	123	97.05	68.00	30.08
(ii) 14-16	118	89.06	66.50	38.13
(iii) 16-18	55	89.14	73.50	43.63
(iv) 18-19	10	55.50	51.00	70.00
(3) Menarche				
(i) Before	157	99.21	71.74	34.39
(ii) After	147	82.83	70.15	46.25
(4) Grade of goitre				
(i) Oa	200	104.2	69.5	28.00
(ii) Ob	84	72.5	64.0	52.00
(iii) I	29	54.8	54.0	68.00
(iv) II	02	50.5	35.0	50.00

NEONATAL HYPOTHYROIDISM IN SURAT DISTRICT

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Pregnant women in iodine deficient environment may give birt to hypothyroid child. Hypothyroidism in children later on in manifes as low IQ, mental retardation, physical growth retardation deafmutism, myxoedematous cretin or nervous cretin.

Irreversibility of associated health consequences and importance of early detection and treatment in minimising permanent damage indicate importance of screening of neonates for hypothyroidism.

Material and Method

Cordblood samples of newborns were collected from Surat Bardoli, Ukai, Vyara hospitals. Cordblood samples were collected on filter paper (Whatman no. 3). Blood drop about the size of one rupees coin was put on the filter paper and dried. All samples were stored in cool dry place and were protected from exposure to direct sunlight. Analysis of cordblood samples was done in the Endocrinology Department of AIIMS, New Delhi by radio immuno assay.

Surat, Bardoli, Ukai and Vyara hospitals represent seashore area with normal Iodine environment, central area with moderately iodine deficient environment and eastern hilly area with iodine deficient environment respectively.

Result and Discussion

For a long time goitre was the only recognized health consequence due to iodine deficiency and other goitre associated health consequences were neglected due to inadequate recognition as a public health problem. One of the reason for this was unawareness regarding the magnitude of this problem.

Smith (1975) reported that neonatal hypothyroidism occurred once in approximately 6,000 births. Because of lack of conspicuous clinical features the diagnosis is rarely suspected within the first few months of life.

Topography of Surat district provides unique opportunity to study neonatal hypothyroidism in relation to various gradients of natural environmental iodine.

At AIIMS laboratory the cord blood samples were initially nalysed for thyroxine. When the value was less than 2 S.D. of the nean of the corresponding non-endemic area, thyroid stimulating ormone (TSH) was also estimated. TSH of 50 ug/dl is considered as ypothyroidism (Pandav and Kochupillai, 1984).

Table No.1

Distribution of neonates according to their cordblood thyroxine levels.

Thyroxine in cord blood ug/dL	Sample size	
	No.	(%)
2.0 or less	14	6.03
2.1 - 4.0	41	17.67
4.1 - 6.0	74	31.89
6.1 - 8.0	95	40.95
8.1 - 10.0	8	3.45
Total	231	100.00

Mean = 4.85; S.D. = 1.86

Distribution of neonates according to their cord blood thyroxine evels (T4) is shown in table No. 1. As high as a 44.4% samples had 4 level 6.0 ug./dl. The mean thyroxine level was 4.85 +/- 1.86 g/dl. 6.03% of the neonates had level of less than or equal to 2 g/dl.

Table No. 2

Mean thyroxine level in cord blood of neonates according to area.

Thyroxine level (ug/dl)	Surat (N=120)	Bardoli (N=37)	Ukai (N=27)	Vyara (N=48)
Mean	5.9	5.2	4.7	4.6
S.D.	1.62	2.15	2.1	1.99
% of hypothyroid Samples	3.3	5.4	7.4	12.5

Value of Z test for T_4 level Significant

(1) SURAT Vs UKAI Z = 2.85 Significant

(2) SURAT Vs VYARA Z = 4.19 Significant

Table no. 2 shows mean thyroxine level in cord blood o neonates in different areas. It was highest in Surat and lowest i Vyara. Levels for Ukai and Vyara were significantly lower than Sura area. Thus mean cord blood thyroxine level was significantly highe in seashore area and lower in eastern hilly area of Surat district According to the criteria adopted by AIIMS for diagnosis o hypothyroidism in cord blood samples prevalence rate of neonata hypothyroidism was 3.3% in Surat, 5.4% in Bardoli, 7.4% in Ukai and 12.5% in Vyara.

No significant difference in prevalence rate of neonata hypothyroidism was observed between male and female neonates, i relation to rank of the child and in relation to birth weight of th child.

Study of water iodine level of Surat district supports th environmental iodine gradient whereby Vyara has lowest leve followed by Ukai, Bardoli and Surat with consistently increasin level Prevalence rate of neonatal hypothyroidism in present stud shows inverse trend and indicates role of environmental iodin deficiency in neonatal hypothyroidism

IODINE DEFICIENCY AND DEAFMUTISM

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Deafmutism (Congenital deafness DM) is one of the IDD manifestation. As this disability is not noticeable initially it is difficult to assess its magnitude. According to National Sample Survey (1983) prevalence of deafmutism was 0.51/1000 in India. ICMR multicentric study (1989) also revealed deafmutism ranging from 0.01 % - 2.5 % in different centers. Surat centre in this study had 0.1 % prevalence rate of deafmutism. During this study in Surat district it was realised that large number of deafmute children even from remote tribal villages were admitted in special school for their rehabilitation. It was also observed that villages with more than 30 % goitre prevalence rate had higher prevalence of DM than other villages.

Looking at the prevalence rate of DM and non availability of children for study at their residence, an epidemiological study of DM persons was conducted in the residential school at Kachholi which has the highest number of registered students in Gujarat.

Aim of the study was to explore various causative factors in DM and health profile of DM students of the school with an emphasis on the role of IDD in the causation of DM.

From total 347 registered students 329 were available for study, 66.6 % were male students, 46.9 % students were in 11- 15 years, 28.5 % students were in 5-10 years, 21.5 % students were in 16-20 years and 3.1 % were in above 21 years age group. Out of total, 97.4 % students had no ear lesion, 93.4 % had severe and remaining had moderate deafness (confirmed by audiometry).

Detailed history of native place, birth, family health was compiled by family visits. In 33.2 % cases, no obvious environmental cause was revealed in 35.8 % cases IDD could be revealed as cause while in 29.5 % and 21.6 % cases postnatal and prenatal environmental factors could be explored.

IDD as a cause of DM was considered in those cases who where natives (born and brought up before admission) located in

iodine deficient area, had family members with goitre, case having goitre and by thyroid hormones estimation in subsample. Accordingly 33.0 % of DM students were natives of iodine deficient zone, 35.6 % of them had goitre in family and/or in them and 32 % of cases tested for thyroid hormones had hypothyroidism.

Further analysis of cases brought out the information that iodine deficiency was the single major environmental cause and autosomal recessive type of genetic transmission was the single major mode of transmission for DM. Out of these two single major causes identified, DM is easy to prevent through IDD control programme.

Projection can be made from present study that IDDCP can help in prevention of about 30 % DM which is irreversible untreatable but a preventable disability.

GOITRE ASSOCIATED HEALTH CONSEQUENCES IN GUJARAT.

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Endemic goitre is one of the consequences of iodine deficiency and represents compensatory phenomenon in the gland due to decreased iodine supply. Serious consequences which co- exist with goitre in iodine deficient areas are hardly recognised and reported.

In multicentric study on epidemiological survey of endemic goitre and endemic cretinism, any individual with one or more abnormalities like feeble mindedness, deafmutism, gait defect, sguint, hypothyroidism, nervous cretins was considered as cretin (ICMR 1989).

These changes of cretinism are irreversible and untreatable. Assessment of their magnitude reflects the severity of consequences of iodine deficiency in the community.

Present study aims at epidemiological study of goitre associated health consequences in four districts of Gujarat State.

Material and Method

Four districts namely Surat, Dang, Sabarkantha and Amreli representing the length and breadth of Gujarat State were studied for goitre prevalence. Sampling technique recommended by NGCP was applied and 1 % of population and 5 % of school children from every geographical zone were surveyed. During goitre survey simultaneous information of associated health consequences as per ICMR multicentric study were recorded.

Results and Discussion

Endemic goitre and endemic cretinism are geographically co-incident though not all goitre endemic areas have endemic cretinism (PAHO 1974.)

Table No. 1

Prevalence rate of goitre and associated health consequences in four districts.

District	Population surveyed	Goitre Prevalence rate (%)	Associated health consequences prevalence rate (%)
Surat	45005	22.45	0.4
Dang	3371	53.25	0.9
Sabarkantha	28515	35.34	0.5
Amreli	22276	15.68	0.06

Prevalence rate of goitre and of associated health consequences in four districts (table no. 1) reveal similar trends. Regional distribution and different gradients indicate role of environmental iodine deficiency and associated health consequences as well as co-existence of both in the study area (table no. 1).

Table No. 2

Goitre associated health consequences in relation to natural iodine environment.

District	Prevalance rate (%)		
	Seashore	Plains	Hilly area
Surat	0.1	0.3	0.9
Sabarkantha	—	0.4	0.9

Dang district has a hilly terrain while Amreli is mainly plains. In Surat and Sabarkantha districts goitre associated health consequences were highest in talukas with hilly terrain and in Surat district it was lowest in taluks near seashore (table no. 2). These findings also support role of environmental iodine deficiency in goitre associated health consequences.

Like goitre prevalence rate, prevalence rate of associated health consequences was higher in females (0.7%) than in males (0.4%)

Similar observations are reported in the ICMR multicentric study (1989) covering twelve states with 0.7% overall prevalence rate and prevalence rate of 0.5% in male and 0.9% in female.

Table No. 3

Percent distribution of goitre associated health consequences in relation to age in a survey of 9454 persons from Surat district.

Age (yrs.)	Percent distribution	
	All health consequences (N=77)	Typical cretins (N=10)
0 - 5	8.0	10.0
6 - 12	31.0	30.0
13 - 19	27.6	40.0
20 - 29	17.2	20.0
30 - 39	6.8	---
40 - 49	5.7	---
≥ 50	3.4	---

Distribution of cases of goitre associated health consequences from the survey of 9454 persons from Surat district is shown in table no. 3. A total of 8.0% cases were in 0-5 years age group. Maximum cases (31.0%) were in the 6-12 years age group then there is a consistently declining trend in percentage distribution of cases with increasing age and lowest was in more than 50 years age group (3.4%). Distribution of cases with typical cretinism in relation to age revealed that percentage of cases were highest (40.0%) in the 13-19 years age group followed by 6-12 years age group (30.0%), 20-29 years age (20.0%) and 0-5 years age group (10.0%). There was not a single case of typical cretinism beyond the age of 30 years. As per criteria adopted by ICMR multicentric study (1989) any individual with one or more abnormalities which are defined to identify cretin was considered as a case of goitre associated health consequences.

Out of total such cases recorded 44.9 % had feeble mindedness, 34.5 % had deafmuusm, 14.9 % had gait defect, 14.1 % had stunted growth, 21.3 % had sguint, 31,0 % had hypothyroidism and 11,0 % had diaplegia or quadreplegia suggestive of nervous cretinism.

Only 1 % individuals with associated health consequences had goitre against 0.67 % individuals without associated health consequences. Thus goitre is not always present in individuals with associated health consequences and the terminology of goitre associated health consequences is for an endemic area and not for an individual.

A STUDY OF KAP REGARDING IDD AMONGST TRIBAL POPULATION OF SURAT DISTRICT.

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Though severity of IDD in Surat district may be less, it deserves ttention due to its vicinity ,with the western ghats and the fact that it s mainly inhabited by tribals. Several studies have highlighted that his group suffers maximum from IDD. When a programme to ontrol IDD is to be introduced the knowledge, attitude and practices KAP) study of this specific group will be very useful in supporting he programme by health education.

Present study aims to study KAP amongst tribal population for oitre problem.

Material and Method

Study was conducted amongst 918 families from (Panchol, Ukaradha and Veldha) 3 PHC area of tribal region situated in eastern art of Surat district. Twenty Villages from these PHCs were andomly selected to have 5% of families from each PHC. Every ouse of the sample villages was visited. KAP information was ollected by interview in pretested form from one adult per family.

esults and Discussion

Review of National Goitre Control Programme indicates that the actor responsible for unsatisfactory performance of this programme n our country is "no attempts" to publicise the programme, educate he people and mobilize their demand for the services at the grass oot level.

Out of 918 families, 288 (31.4%) were aware of goitre in the rea. Almost two-third of the families were unaware of existence of DD as a health problem. Majority of those aware of the problem lentified it either as Raholi or Rasoli (20.0%) or as as Ghoghivadh r Ghoghisoja (6.2%) or as Kanthmal (4.3%).

Langer (1960) noted that in middle ages the cause of the goitre as been regarded as being a visitation of God. In the present study s many as 90% families had no idea regarding the cause of the

disease, remaining attributed it to heredity (4.5%), food and disea (1.8%) and to pregnancy and delivery (3.6%).

Ancient literature mentions about use of seaweeds in treatme of goitre and a magic touch of monarch for cure of goitre. A total 89% families had no information regarding traditional treatment belief for cure of goitre. Remaining reported branding, tying thre around neck and going to religious healers for treatment of goitre.

More than 50% families were ignorant about oth consequences of goitrous environment, 20% considered goitre harmless and only 16% believed that it is harmful. About 60% famili were unsure about the need of treatment in goitre while 7% firm believed that it does not require any treatment.

Further, 66.0% families were unaware of any soci consequences arising from goitre, 24.3% informed that it creat problem in marriage settlement of girls, and 2.6% feared outcasti due to it. Out of 60 families having goitre of grade II or more, on eight families had consulted any health personnel.

Different methods for iodisation namely iodised salt, iodised (injection or oral) were explained to families as preventive a control measure. A total of 75% families reacted indifferently to 20.8% showed willingness to accept iodised salt while 2.2% we willing to go for iodised oil injection.

EPIDEMIOLOGICAL STUDY OF GOITRE IN A FLUOROSIS ENDEMIC DISTRICT OF GUJARAT

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Toxic effect of fluoride on the thyroid gland is suspected since ng (Demole, 1970). A high prevalence of goitre has been observed countries where skeletal fluorosis is endemic (Mc.Laren, 1969). ontroversy still exists due to conflicting results in several animal and uman studies (Demole, 1970).

In India the problems of endemic fluorosis and endemic goitre ave been reported from 15 and 12 states respectively. with gnificant overlapping of the problem in some regions. Such idespread co-existence provides an oppurtunity to conduct pidemiological studies for better understanding the interactions of e trace elements involved, the effects on human health, and ethods of control and prevention.

laterials and Methods

The Amreli district is in the Saurashtra region of Gujarat. It has en administrative blocks, two with hilly terrain. The major source of rinking water is ground water.

Meterial and methods include clinical examination of 10,029 esidents by a house to house survey and 12,247 children by a school urvey, covering 1% of the total population and 5% of school hildren of randomly selected villages, conformed to WHO ecommendations for a goitre survey (Perez, 1960), water samples ere collected from all drinking water sources. Fluoride and iodine stimations were carried out, with an ion-specific electrode and tration method, respectively.

esults and Discussion

Amreli district was the first identified fluorosis endemic district Gujarat. The overall prevalence of dental fluorosis was 12.2% and f goitre 14.0%. Age specific prevalence rate of dental fluorosis and oitre (table no. 1) show that both problems were predominant in chool children and young adults.

Amongst the studied blocks, dental fluorosis prevalence ranged om 6.0 to 59.0%, and goitre from 9.5 to 37.5%. Distribution of

blocks according to dental fluorosis and goitre prevalence (table
2) shows that only one block had goitre prevalence <10%. In t
blocks with goitre prevalence more than 20%, dental fluoro
prevalence was more than 50%. There was a significant posit
correlation between prevalence of goitre and dental fluorosis in
study area (r=0.4926).

Iodine deficiency is the major cause of goitre endemicity (m
than 10% prevalence) in India. In the study area, all but one of
blocks had goitre prevalence conforming to WHO criteria
endemicity (Perez, 1960). An earlier study of goitre and associat
health consequences in Surat district of Gujarat state (Jagirdar, 19
revealed goitre endemicity in regions with water iodine less than
ug/litre. In the present study goitre endemicity was present in
district blocks with water iodine of more than 20 ug/litre. Moreov
there was no significant correlation between water iodine level a
goitre prevalence (r=0.1443).

The significant correlation between prevalences of goitre a
dental fluorosis, and the absence of any significant correlati
between water iodine level and goitre prevalence, indicates
probable role of fluoride toxicity in the development of goitre cas
It is further supported by the fact that dietary patterns were unifo
in the study area and the use of goitrogen containing foods was
predominant in any block.

In the study area there was no village with a water fluoride le
less than 1 ppm (the "safe" limit) and a water iodine level less th
10ug/litre(which leads to high IDD endemicity).In regions wit
normal iodine environment (water iodine level more than
ug/litre), goitre prevalence was significantly higher in regions w
more than 2 ppm water fluoride level(17.1%). The present study t
indicates that fluoride toxicity in a normal iodine environment
cause a goitre problem. A study in Andhra Pradesh has also revea
direct correlation between water fluoride level and goitre in 14
years age (Siddiqui, 1969). While a study of 17 Himalayan villa
showed a positive correlation between goitre prevalence rate a
water fluoride level in the presence of uniformly low water iod
level (Day and Powell Jackson, 1972).

According to Stanbury's classification of goitre (1974)
prevalence of visible goitre (Grade II and more) was only 0.3% in
study area. In districts of Gujarat state with endemic goitre due

iodine deficiency, visible goitre prevalence was 5.8%. Thus there were more early goitre cases in the study area than is usually seen in goitre endemic areas.

Goitre cases were clinically euthyroid in the present study, and cases with clinical manifestations suggestive of cretinism were significantly lower (0.1%) than in the endemic goitre zone (0.9%)in Gujarat State (Desai, 1989). These observations indicate that goitre due to fluoride toxicity does not have functional changes and does not affect the hormonal profile in the community under study. Large scale demographic surveys in U.S.A. and Great Britain have also indicated that drinking water fluoride does not impair thyroid function (Shashi, 1988).

Attempts have been made to study the mode of action of fluoride on the thyroid gland. Experimental studies in animals have suggested, hypertrophy of parafollicular cells and high glycerophosphate dehydrogenase activity (Poonam Khan, 1985), increased lipid component, total lipids and triglyceride (Shashi, 1988), resulting from high fluoride intake. Whether or not a similar mechanism is in operation in human beings in endemic fluorosis areas is not known. Whether these changes are responsible for small enlargements of the thyroid is also not known.

Controversies about fluoride toxicity on the thyroid gland still remain. But this study confirms the widespread co- existence of fluorosis and goitre, and indicates the need for uniform epidemiological field studies in different part of the country, supported by laboratary investigations into water chemistry, dietary iodine and fluoride estimations, thyroid function tests and fluoride metabolism, to explore the mode of action of fluoride toxicity on the thyroid gland and its consequences on human health.

Table No.1

Age specific prevalence rate of dental fluorosis and goitre

Age (years)	Prevalence rate (%)	
	Dental fluorosis	Goitre
< 5	1.5	2.6
5 - 12	16.3	16.8
13 - 19	15.4	21.4
20 - 30	15.3	21.2
31 - 40	15.1	16.4
>40	9.6	6.4
Total	12.2	14.0

Table No. 2

Distribution of blocks according to prevalence of dental fluorosis and goitre

Goitre prevalence rate (%)	Prevalence rate (%) of dental fluorosis			
	< 10	10 - 20	> 20	Total
> 10	1	–	–	1
10 - 20	1	5	1	7
> 20	–	–	2	2
Total	2	5	3	10

STUDY OF GOITRE IN RELATION TO DRINKING WATER QUALITY IN TRIBAL VILLAGES OF SURAT DISTRICT

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Food though is a major source of iodine for human beings, water also forms an important source in tropical countries due to high per diem intake. Water iodine level reflects natural environmental iodine level and goitre prevalence rate in endemic area shows inverse correlation to water iodine level.

High calcium hardness and high fluoride content in drinking water are regarded as important ecological factors contributing to goitre in India. Mc Carrison (1906, 1908) in Himalayan belt (Gilgit) first time drew attention to the role of water pollution (organic contamination) in development of goitre endemicity.

Present study aims at the assessment of goitre prevalence rate in relation to quality of water in tribal villages of Surat district.

Material and Method

Study was conducted in the villages of three primary health centres - Panchol, Ukhalda and Veldha located in eastern hilly tribal area of Surat district. Total number of villages surveyed were 8,5 and 7 respectively from these PHCs.

A total of 3928, 2422 and 3104 individuals were clinically examined for goitre from villages of Panchol, Ukhalda and Veldha respectively. Villages under survey were randomly selected for eastern hilly zone of Surat district as a part of ICMR multicentric study.

Drinking water samples from all the sources of villages under study were analysed for iodine, calcium hardness fluoride level and bacterial contamination (E.Coli.) by the standard methods.

Results and Discussion

Inadequate iodine content in food and drinking water is the single most important causal factor in endemic goitre (Hetzel, 1970). Water iodine which is easier to measure than food iodine, is a sensitive indicator of environmental iodine status and is also helpful in identification of "IDD at risk" zones.

Table no 1 shows water iodine concentration from all water sources in 20 villages of 3 PHCs. All 66 sources showed a wide range (1.0 mg/litre - 46.0 mg/litre) with mean water iodine content as lowest in Panchol (2.4 mg/litre) followed by Ukhalda (8.3 mg/litre) and Veldha (9.8 mg/litre). Thus mean water iodine water level was 10 mg/litre in all PHCs area. Goitre prevalance rate was higher (28.3%) in the population consuming river water than well water (19.4%).

In present study goitre prevalance rate was significantly higher (36.0%) with 10 mg/litre water iodine concentration. While goitre prevalance rate was not significantly different between 11-20 mg/litre and 21-30 mg/litre. water iodine level in drinking water. (Table no.2)

Agrawal (1983) in Narmada valley area and McCarrison (1906, 1908) in Himalayan region highlighted role of bacterial pollution of drinking water in goitre prevalance. In present study (Table No. 3) prevalance rate was significantly higher in presence of water contamination . This difference was marked at 10 mg/litre water iodine level. It indicates that at low water iodine level bacterial contamination plays significant role on goitre prevalance.

Table no. 4 shows goitre prevalance rate in relation to calcium hardness. In total study group and in group with ≤10 mg/litre water iodine level goitre prevalance rate was significantly higher when calcium hardness level was ≥75 mg/litre. It suggests that calcium hardness of water plays important role at lower level of water iodine in study area. Calcium is thought to inhibit the synthesis of thyroxine and thus increases the iodine requirement (Taylor-1954)

Iodine and fluorine are considered competitive. Water fluoride and iodine level in water sources under study showed negative significant but weak correlation. All water sources had fluoride level within permissible limit 1.5 ppm. In present study 0.5 ppm water fluoride level did not significantly increase goitre prevalance rate at any level of water iodine concentration. Water fluoride level within permissible limit fails to exert inhibitory action on thyroid cells and does not act as a goitrogen.

Present study indicates that in addition to iodine deficiency in water other parameters like bacterial contamination, calcium hardness and fluoride concentration also play an important role in determining goitre prevalance rate. Present study also reveals that

bacterial pollution and high calcium hardness have significant effect on goitre prevalance rate when water iodine content is lower than 10 mg/litre in study population.

Table No. 1

Water iodine concentration in villages of three tribal PHC of Surat district

PHC	No. of villages	No. of Water samples	Iodine level (mg/litre)	
			Mean	Range
Panchol	8	26	2.46	0.1 - 10.1
Ukhalda	5	29	8.26	0.3 - 46.0
Veldha	7	11	9.86	0.3 - 27.0

Table no. 2

Goitre prevalance rate in relation to water iodine concentration

Sr. No.	Water iodine mg/litre	Population examined	Goitre cases	Prevalance rate (%)
1.	0 - 10	8140	2932	36.0
2.	11 - 20	404	92	22.7
3.	21 - 30	910	266	29.2
	Total	9454	3290	34.8

Value of Z test

(i) Between 1 and 2 = 2.9 (Significant)

(ii) Between 1 and 3 = 2.3 (Significant)

(iii) Between 2 and 3 = 1.24 (Non significant)

Table No. 3

Goitre prevalance rate in relation to iodine concentration and organic contamination

Sr. No.	Water Iodine (mg/litre)	With contamination	Without contamination
		Prevalence rate (%)	Prevalence rate (%)
1.	0-10	34.1	28.9
2.	11.20	20.7	19.5
3.	21-30	22.5	31.9
4.	**Total**	31.9	27.5

Value of Z between contamination and No contamination in

(i) Z = 4.7 (Significant) (ii) Z = 0.6 (Non significant)

(iii) Z = 2.52 (Significant) (iv) Z = 4.2 (Significant)

Table No. 4

Goitre prevalence rate in relation to calcium hardness and iodine concentration in drinking water

Sr. No.	Water iodine (mg/litre)	Water calcium hardness (>75 mg/l)	(≥75 mg/l)
		Prevalence rate (%)	Prevalence rate (%)
1.	0 - 10	31.4	34.3
2.	11 - 20	20.7	19.5
3.	21 - 30	29.7	---
	Total	29.5	31.4

Value of Z between samples with calcium hardness (mg/L) as below 75 mg and above :

(i) Z = 2.6 - Significant

(ii) Z = 0.6 - Not significant

(iv) Z = 2.03 - Significant

Table No. 5

Goitre prevalance rate in relation to water Iodine and Fluoride concentration

		Water fluoride level	
		(<0.5 ppm)	(≥0.5 ppm)
Sr. No	**Water iodine (mg/litre)**	**Prevalence rate (%)**	**Prevalence rate (%)**
1.	0 - 10	43.1	27.6
2.	11 - 20	—	23.1
3.	21 - 30	27.0	27.3
	Total	42.6	26.4

Value of Z between samples with fluoride level <0.5 and ≥ 0.5 ppm

(i) Z = 13.0 - Significant

(iii) Z = 0.07 - Not significant

(iv) Z = 16.8 - Significant

EVALUATION OF THYROID FUNCTION OF PATIENTS AT LIONS CANCER DETECTION CENTRE, SURAT. (1989-1993)

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Thyroid function tests, in the form of Thyroid Hormone Assays, Thyroid Uptake and Thyroid Scan are routinely performed at Lions Cancer Detection Centre Trust, Surat. Over the past five years (1989-1993) there has been a steady increase in the number of patients, who are referred for evaluation of thyroid status. The major aim of the study was to determine if the introduction of iodized salt in the recent years changed the profile of thyroid function status. It was also sought to obtain a cross- sectional view of the kind of patients presenting to our Centre.

Materials & Methods

All the patients referred to Lions Detection Centre were subjected to either thyroid hormone assay or thyroid uptake or scan. From Jan-1989 to Jan-1993 only serum T-3 & T-4 levels were estimated. If necessary TSH levels were obtained from an outside laboratory. From Feb-1993 onwards Serum T-4 and Serum-TSH (Supra-sensitive IRMA Kits) were estimated. Clinical correlation with the study results was performed and the results analysed.

Results

A. Cross-sectional View of Thyroid Function in Patients over 5 years
(1989-1993) (Table 1)

The total number of samples evaluated for Thyroid function rose steadily from 414 in 1989 to 828 in 1993.

The rate of hypothyroidism ranged from lowest (8.6%) in 199 to highest (9.9%) in 1990, with an average of 9.4 %, indicating no major change in the incidence of hypothyroidsm over the study period.

The rate of hyperthyroidism ranged from lowest (9.2%) in 199 to highest (13.2%) 1991 with an average of 11.9%. There is a declin in hyperthyroidism, which is not actual apparent as many ol

hyperthyroid patients who come for follow-up are now euthyroid after anti-thyroid therapy (they result in increased number of cases in recent years).

Naturally the percentage of euthyroid patients also remains relatively same, ranging from 77.2% to 81.0%.

B. Cross-sectional view of new patients sent for thyroid functional evaluation
in 1992.

A total of 693 new patients were seen in 1992. However, only 626 patients underwent thyroid function evaluation finally. Remaining could not be tested biochemically (common cause being 'no-show'). Out of the 494 females, who were evaluated for thyroid function (table no. 2), 11.3% exhibited hyperthyroidism and 15.2% showed hypothyroidism. Similarly out of 132 males evaluated 17.4 exhibited hyperthyroidism and 7.6% hypothyroidism. In both sexes, the maximum number of patients were aged between 30 to 40 years. In fact, nearly 70% of the patients were aged between 20 to 50 years (table no. 3)

An analysis of the thyroid morphology revealed that nearly 55.1% of the patients were agoitrous, 28.3% had simple goitre, 4.8% had multi-nodular goitre and 11.8% had solitary thyroid nodule (table no.4).

Further, out of 345 agoitrous patients 269 (78%) were euthyroid, 16 (4.6%) were hyperthyroid and 60 (17.4%) were hypothyroid. Simple and multinodular goitres displayed similar incidence of hyperthyroidism (27% - 30%) and hypothyroidism (10% - 12%). Solitary nodules exhibited the sole abnormality of thyrotoxicosis (autonomous toxic nodule) in about 6.8% cases. An analysis of the thyroid functional status revealed 74.0% of the patients as euthyroid, 12.5% as hyperthyroid and 13.5% as hypothyroid.

Further, of the hyperthyroid patients, 20.25% were agoitrous, 11.5 had multinodular goitre, 61.5 had simple goitre whilst 6.5% had solitary thyroid nodule.

As opposed to the above, of the hypothyroid patients, 70.6% were agoitrous, 3.5% had multinodular goitre, 25.9% had simple goitre and none had solitary thyroid nodule.

Among the 626 patients, there were 42 known hypothyroid patients, already on medication. of these 28 (66.6%) were euthyroid,

indicating that they were receiving proper dosage of exogenous hormone, 1 (2.4%) had overdosage and 13 (31%) had residual hypothyroidism. Similarly among 36 known hyperthyroid patients, already on medication 10 (27.8%) were euthyroid, 22 (61.1%) had residual hyperthyroidism, and 4 (11.1%) showed signs of overdosage of carbimazole.

Conclusions

A. Comparison of figures for thyroid function over 1989-1993:

1. The number of samples evaluated for thyroid function by T-3, T-4 or TSH RIA rose steadily from 414 in 1989 to 828 in 1993.
2. There was no major change in the incidence of hypothyroidism (average 9.4%) and hyperthyroidism (average 11.9%) over the past 5 years (1989 to 1993).

B. Analysis of new thyroid patients referred during 1992:

1. 693 new patients were referred for thyroid function evaluation. Of these 626 (494 females and 132 males) underwent biochemical evaluation.
2. Maximum patients (70%) presented in the 3rd, 4th and 5th decades.
3. 53% of the thyroid patients were agoitrous. Of these only 4.6% showed hyperthyroidism and 17.4% hypothyroidism.
4. 29.2% of the thyroid patients had simple goitre. Of these 27.1% showed hyperthyroidism and 12.4% hypothyroidism.
5. 4.8% of the thyroid patients had multi-nodular goitre.Of these 30% showed hyperthyroidism and 10% hypothyroidism.
6. 12.5% ofthe patients exhibited hyperthyroidism. Of these 61.5% had simple goitre, 11.5% had multi-nodular goitre and 6.5% had solitary thyroid nodule.
7. 13.6% of the patients exhibited hyperthyroidism. Of these 25.9% had simple goitre, 3.5% had multi-nodular goitre and none had solitary thyroid nodule.
8. Two thirds of the known 42 hypothroids, whilst only 27.8% ofthe 36 known hyperthyroids were euthyroid, indicative of adequate therapy.

Table No. 1

Thyroid functions 1989-1993

Year	Euthyroid	Hyperthyroid	Hyperthyroid	Total
1989	325 (78.5)	51 (12.3)	38 (9.2)	414 (100.0)
1990	335 (77.2)	56 (12.9)	43 (9.9)	434 (100.0)
1991	447 (77.4)	76 (13.2)	54 (9.4)	577 (100.0)
1992	513 (79.5)	77 (11.9)	55 (8.6)	645 (100.0)
1993	671 (81.0)	76 (9.2)	81 (9.8)	828 (100.0)

Figures in parentheses indicate percent values.

Total No. 2

Thyroid function diagnosis in male and female (N=626)

Thyroid Status	Female	Male	Total	Male female ratio (per female)
Euthyroid	364 (73.6)	99 (75.0)	463 (74.0)	0.27
Hyperthyroid	55 (11.3)	23 (17.4)	78 (12.5)	0.42
Hypothyroid	75 (15.1)	10 (7.6)	85 (13.5)	0.13
Total :	494 (100.0)	132 (100.0)	626 (100.0)	0.27

Figures in parentheses indicate percent value.

Table No. 3

Age distribution of patients screened for thyroid function (N=693)

Age (years)	Female	Males	Total
0 - 10	13	8	21
11 - 20	47	16	63
21 - 30	128	36	164
31 - 40	168	37	205
41 - 50	95	18	113
51 - 60	51	24	75
61 - 70	37	5	42
ô71	4	5	9
Total	544	149	693

Table No. 4

Thyroid morphology and thyroid function.

Morphology	Euthyroid	Hyperthyroid	Hypothyroid	Total
Agoitrous	269	16	60	345 (55.1)
MN Goitre	18	9	3	30 (4.8)
Simple Goitre	107	48	22	177 (28.3)
Solitary Nodule	69	5	0	74 (11.8)
Total	463 (74.0)	78 (12.5)	85 (13.5)	626 (100.0)

Figures in parentheses indicate percent values

Table No. 5

Treatment response of patients (N=626)

atients nitial status)	Treatment - Response			Total
	Euthyroid	Hyperthyroid	Hypothyroid	
. Known Hyperthyroid	28	1	13	42 (6.7)
. Known Hyperthyroid	10	22	04	36 (5.8)
. New cases	425	55	68	548 (87.5)
otal	463 (74.0)	78 (12.5)	85 (13.5)	626 (100.0)

Figures in parentheses indicate percent values.

MILE STONES OF GOITRE SURVEY-BHARUCH DISTRICT (A REVIEW)

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It is the Bharuch district where for the first time goitre cases were reported by Sir McCarrison in 1913-14. He reported that "People living in the valley of Narmada in Gujarat suffer more from Goitre".

After a long pause this was followed by a community study "Endemic goitre in Narmada valley in Bharuch district, Gujarat" (Edibam et al, 1972). Summary of their observations are as follows:

"Total population examined was 1374 from nine villages with overall prevalence of 36.7%. Classified in grade I were 28.1%, grade II 7.1% and grade III 1.6%. No patient had pressure symptoms. The prevalence was highest in the age group of 6-11 yre. There was no increased prevalence in female over the male in the age group 12 years and above.

Population drinking Narmada river water had prevalence between 25-30%, and those drinking water from rivulets had between 19-63%. All families consumed diet deficient in proximate principles. No goitrogenous food of brassica family was grown and consumed by the families.

Iodine content was too low in all the samples. There was no apparent relationship between hardness and chloride level with goitre prevalence rate.

Hospital records from Nandod taluka were woefully deficient in showing the presence of the disease in this area. Treatment is indicated for 36.7% of the population. This will be possible through the existing hospitals and village teachers. The distribution of iodated salt through the licensed ration shop will be essential".

In 1977 NGCP team surveyed Bharuch district and indicated overall prevalence rate of 31.4 - 33.9 % (details are already given in districtwise survey), in 1979 another team (Trivedi et al, 1979) in their study made following observations:

"Survey of 25 villages and 1 town along the bank of Narmada and Karjan covered a total 6550 persons including 3898 from villages

nd remaining from Rajpipla town. Total goitre cases in village were 96 and Rajpipla 503 with overall prevalence rate of 22.89%. Of hem, 87.25% were in grade I, 9.66% in grade II and 3.09% in grade II. In many grade III patients, goitre nodules were felt. No cretin hild or myxoedematous adult or thyrotoxic adult was found.

Prevalence rate was highest in 11-20 years age group. There was significant increase in the prevalence in females (33.1%) over the nales (17.17%) in the age group of 21 years and above. No oitrogenous foods were grown and eaten by villagers. Looking to he very high prevalence of goitre something must be done for revention. Distribution of iodized salt through ration shops is the nly feasible method".

In 1982 iodized salt programme as a part of NGCP was ntroduced. District Magistrate convened a press conference and ssued a legislation to ban entry of non iodized salt and distribution f iodized salt in the area. Iodized salt at that time had centralized roduction and private agencies were not there. Supply was through ivil supply department and salt was sold through Govt. ration shops.

Again in 1983 (Agarwal et al, 1983) as a part of investigations on urrent status of endemic goitre in the country came out with the llowing findings for Bharuch districts.

"Aim of the study was to collect information on the current atus of the endemic goitre in the district and control measures ken by central authorities and role of different type of water supply goitre prevalence.

Spot surveys were carried out in schools and villages and in haruch city. Drinking water samples were collected. Information of revious studies and control measures were collected from District ealth Officer (DHO).

In the Junaraj-Adivasi village isolated in hills with a small rivulet the source of water, 70.2% had goitre of varying degree including persons above 18 years with grade 3-4 goitre, The soil sample ntained no Iodine. Another village of Tharia on the bank of the er, with river and insanitary well as water sources, showed goitre evalence as 62.3% with 2 persons having grade 3 goitre.

In Vagra, yet another village on the bank of river, people nsumed well water. School children had 36.4% goitre prevalence

and no iodine was present in oil sample.

Two schools from Bharuch showed goitre prevalence of 7.5% and 8.6%.

The data on physicochemical and bacteriological characteristic of drinking water show that prevalence of goitre was high in th villages with pollutied water. It was more so when iodine wa deficient in soil / polluted water.

No medicine was available to treat goitre at PHC. A lady medica officer who visited these tribal villages several times did not recor the problem of goitre.

It will be extremely difficult to enforce legislation for iodized sal in Bharuch district only. Proper education is likely to bring about change. Iodized salt price must be maintained lower than commo Salt".

Author herself (VKD) in 1984 assessed status of goitre problen in Bharuch district and presented the same in WHO Regiona workshop on IDD and Malnutrition at NIN, Hyderabad. Mai observations are summarized as follows:

"Goitre endemicity has been identified by several studies i Bharuch district. The iodized salt programme was launched in 198 and is further extended for next two years. Salt is obtained fro Kharaghoda and stored at taluka headquarters from there it supplied to dealers. Actual utilization and adequacy of supply iodized salt is not known to authorities. Iodized salt purchase wa compulsory for those purchasing ration from Government shop Motivation of people is attempted through press and cinema slide Salt samples are monitored by food inspectors.

Medical officers of PHC are not well informed about IDD general and IDD problem of their area in particular."

Thus goitre problem of Bharuch district has been studied an confirmed by several teams over a period of time and all hav suggested proper planning of control programme with iodized s and community education as well as CME for health staff.

THE GOITRE PROBLEM IN BHARUCH - CURRENT STATUS (1984)

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Endemic foci of goitre have been recently detected in regions outside sub Himalayan region. (goitre belt of India). Gujarat is one of the state with newly explored goitre regions.

Eastern border of Gujarat state is a hilly tribal belt. forming borders of Sabarkantha, Panchmahal, Baroda, Bharuch, Surat and Bulsar districts and including entire Dang district. Population residing in tribal belt of districts form 15 - 100% of total district population.

Bharuch district is covered under National Goitre Control Programme with iodized salt supply, whereas Surat districts is under survey for goitre and associated health consequences.

BHARUCH DISTRICT :

Bharuch district with population of 12,96,451 (1981) is divided in eleven talukas including five in tribal areas with approximately 40% of total district population. Endemic goitre problem was first identified and reported by Niyogi et al (1972) which was followed by survey of National Goitre Survey team in 1977. This team showed overall prevalence rate of 30% with highest goitre prevalence rate in Dediapada area (65.0%) and lowest in Bharuch area (16.7%). Higher prevalence rate was seen in eastern part of district which is a tribal hilly area.

Iodized salt programme was launched in 1982 for two years which was further extended for two more years. Civil Supply Corporation was incharge of iodized salt supply. Iodized salt is obtained from Khraghada (Gujarat) was stored at taluka headquarters from where it was supplied to the dealers. If we consider salt requirement of the district as 10g/head/day total yearly requirement comes to nearly 47,500 quintals for the whole district. However, actual utilization and adequacy of supply is not known to us.

To assure iodized salt utilization by people, it is compulsory to purchase 2 kg salt/month with family ration from government ration shop. Attempts has been made to motivate people for use of iodized

salt through press and cinema slides. In rural area when we talked with people, they showed no objection to iodized salt. However, it is general impression that in urban area non iodized salt is still more commonly used. For monitoring of programme salt samples are collected by food inspectors from shops.

After 1977 survey there was no baseline survey for Bharuch before the launching of control programme, and there has been no follow up survey after the programme also. There is no trained team for goitre survey either at state or district level. No information is available for drinking water iodine level and urinary iodine excretion level in this district. No information is available for other health consequences related to iodine deficiency in this district.

We tried to contact medical officers at all the fourteen primary health centres of the district to know their knowledge and attitude about endemic goitre problem and ongoing control programme in their areas. Ten medical officers (five from tribal and five from non tribal PHCs) responded to our questionnaire. Seventy percent of Medical officers are working in this area for more than one year then also except one all failed to express the magnitude of goitre problem in their area. Only 50% of them could give information regarding duration of programme in their area. None of them could report any other health consequences of iodine deficiency except goitrous swelling in their area. Role of Medical officer in control programme was described as prevention (60%), case detection (50%) and health education (30%).

COMMENTS :

Available information on current status of goitre problem in Bharuch and Surat districts draws our attention to the following points.

There is little involvement of health department in the on going control programme. No baseline survey was conducted before starting the control programme. There is no provision of resurvey after initiation of control programme. All medical and paramedical health staff should be made aware of local goitre problem, other health consequences of iodine deficiency and on going control programme. Salt samples should be collected from families also to evaluate salt utilization by people. In urban area iodized salt is not

accepted mainly because of its appearance, so better quality iodized salt may be put in the market. Information regarding water chemistry, urinary iodine excretion levels should be prepared with cord blood sample collection and analysis which can serve as baseline for future evaluation of the programme.

Our impression of endemic goitre problem based on school health surveys in Surat district has been confirmed by preliminary information available at present for water iodine level and village survey. This survey shall provide systematic baseline data for evaluation of future control programme.

IODISED SALT

1. PRODUCTION TECHNIQUES OF IODATED SALT

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India is sixth in the list of salt producing countries and major part of the salt here is produced by solar evaporation of sea water, sub-soil brine or lake brine. The average annual production of salt along the eastern and western sea coast, in Rann of Kachchh and Rajasthan is about 9 million tonnes. About 35% of this is by about 8000 small salt works. To date, estimated annual requirement of edible salt is 4 million tonnes which is to be iodated. There are about eight varieties of solar salts produced in the country.

Edible salt is the universally accepted carrier for iodine because it is available everywhere, consumed by everyone is cheap, and its luxurious consumption is not possible eliminating the danger of overdosage.

PRODUCTION TECHNIQUES :

It has been reported that iodised salt was produced by adding iodide solution to the brine during the continuous open pan operation. During the process salt crystals forming at the bottom were removed at frequent intervals by means of perforated shovels and allowed to drain on the floor or on racks placed beside the pans. Potassium iodide solution was pumped into the brine supply before delivering it to pan. By controlling feed and evaporation rates, very uniform salt iodization was achieved. Due to the need for skilled supervision the system could not be regarded as suitable for general adoption (2).

In western countries, the culinary habits are quite different and edible grade salt is in refined form with NaCl 99.5 to 99.8% and has uniform salt crystals. The iodisation of this variety is usually out by either spraying technique or by dry mixing using potassium iodide with suitable stablizers. In India, where edible grade salt has allowable impurities upto 4% and has irregular salt crystals with varing moisture content, potassium iodate is recommended as an iodating agent as it is stable and does not require any stabilising agent.(3). Mainly two production techniques for salt iodisation are adopted at present viz. (1) Dry mixing process (2) Wet Mixing

DRY MIXING

Crystalline salt is fed to the enclosed mixing screw conveyor through a hopper with rotary valve. To the salt crystals in mixing screw conveyor, a mixture of powdered iodising agent, 1 part and carrier powder like calcium carbonate, magnesium carbonate, sodium bicarbonate, sodium carbonate 10 part is added by precision feeder. The carrier powder is added to provide a greater bulk of material passage through the precision feeder and to control the degree of mixing of iodising agent with salt. The screw conveyor, rotary valve and precision feeder are coupled to a motor through a suitable set of pulleys and belt. Sometimes precision feeder is provided with separate motor and belt pulley drive. The iodised salt is collected and packed at other end. Dry mixing is also carried out in barrel type or ribbon type batch mixers. This set up is not a continuous process and requires very long time of contact.

Dry mixing plants are operating in Mexico, Guatemala, USSR, South Africa and in India. The process has not been adequate for non-uniform size salt crystals having moisture, and requires longer time of contact.

WET MIXING

Wet mixing process is further divided into two, namely spray and submersion processes

(1) Spray Process - (a) Mechanised spray process (b) Manual Spray Process (c) Drip Process

(2) Submersion process (a) Manual submersion process (b) Mechanised submersion process.

1. SPRAY PROCESS :

Main features of the spray process are as follows :

1. Mechanised process is a continuous process i.e. salt crystals fed at one end of the equipment, delivered at the other end can be packed directly.
2. The process is suitable for uniform size, pure and dry salt crystals. Bigger salt crystals (Badagara variety) cannot be iodated with this process. The process is easily applicable to 6mm - 12mm size crystals.
3. As 3 -4% solution agent is sprayed in the chamber/hopper where salt crystals are falling, for uniform distribution of

iodine, multi point control and comparatively more skilled staff is required.

(a) Mechanised Spray Process :

Raw crystal salt is added to the feed hopper having a rotary valve on the conveyor which delivers the raw salt continuously in a fine layer, into the mixing hopper. The falling salt crystals in the mixing hopper meet a fine sheet of droplets of iodating solution sprayed through nozzles by compressed air. The iodated salt is mixed thoroughly in the screw mixer which delivers the iodated salt at other end. The feeder conveyor, screw mixer are coupled to electric motor and belt pulley system. The air compressor is also driven by a electric motor. Such plants with capacity, 1 TPH to 10 TPH are readily available.

Portable plants with a single engine drive consisting of a feeder hopper with vibrator and rotary valve, mixing hopper, spray nozzles, air compressor, screw conveyor and delivery chute have been designed fabricated and are in operation in Ganhidham, Gujarat. Such plants are suitable for small salt manufacturers who can purchase them on co-operative basis.

(b) Manual Spray Process :

It involves spraying of iodating solution, with the help of a manually operated spray pumps which are readily available in market for agricultural insecticide spraying. After spraying the salt crystals are mixed with wooden spade thoroughly.

Use of manually operated spray pumps for iodating salt in Thailand was filmed by UNICEF and was projected at various seminars and workshop on salt iodization.

(c) Drip Process :

Drip process involves addition of small quantities of iodating solution in the form of drip to salt crystals which are mixed in a mixing hopper and then packed.

Drip system operated in a salt iodization plant at Gandhidham had been reported operating satisfactorily in December 1989.

While selecting a mechanised spray plant, enough care should be taken to select the correct material of construction for solution tanks as well as screw conveyor and to provide suitable interlocking control between spray nozzles and feeder.

II SUBMERSION PROCESS

Main features of the submersion process, developed in CSMCRI, Bhavnagar are as follows.

1. This is a simple batch type process. Electrical power requirement is comparatively low and labour charges are comparatively higher. ,
2. It requires natural draining/drying period of about 24 hours. The raw salt treated can be packed after 24 hours. If necessary, the salt crystals can be ground after iodation without loss of iodine.
3. The process is suitable for small to large size salt crystals (3mm to 30mm). It is not suitable for very fine crystals.
4. As the complete mass of salt is submerged in a weak solution of iodating agent, uniform distribution of iodine is well maintained.
5. Once the quality of salt to be iodated is known, single point control is sufficient for quality control.
6. To a certain extent, superficial magnesium impurity of the salt cyrstals can be removed by controlling the magnesium content of the process solution.

(a) Manual Submersion Process :

The salt crystals are spread uniformly in the process tank. The saturated salt solution containing iodating agent from solution tank is pumped into the process tank till the salt is submerged. The salt is then allowed to drain for about 6-8 hours. During this period all the excess solution is drained into the solution tank. The salt is then transferred to adjacent platform where it is subjected to solar drying for 18 - 16 hours.Afterwards the dried salt is ground, if required, packed in polythene lined bags. After preparing make up solution tank, the same solution is reused for the next batch.

Salt crystals are fed to the inclined screw mixer through the hopper, and later submerged in the iodated salt solution which is

pumped into the mixer. Due to the inclination of screw mixer excess solution drains into the hopper and when when there is a large excess, of overflows back to the solution tank. A big heap of iodated salt is formed on the platform by a stacker. The excess adhering solution drains from the salt crystals back to the solution tank. The dried iodated salt crystals are ground if required or packed.

It is reported that in South India, salt department has permitted small manufacturers to encourage a process termed as batch type mechanised submersion process and involves submerging and mixing salt crystals in a cement concrete mixer. The mixer is operated for about five minutes.

2. IODIZED SALT FOR PREVENTION OF GOITRE

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Iodine deficiency commonly leads to GOITRE - swelling of hyroid gland. Thyroid gland has important function in our body, as controls growth, development and various metabolic functions by he secretion of thyroid hormones.

In order to meet the deficiency of iodine, it is suggested:

1) To supply iodine through bread, as is done in USA. It is not suitable for vast number of our rural population, as they do not consume bread in their daily diet.
2) To supply iodine through water, as is done in China and Thailand. It is not practicable and expensive and therefore not suitable for us, as only small quantity of water is used for drinking and cooking and the remaining for washing and bathing. Thus iodine is wasted without proper use.
3) The use of iodized salt is accepted as the most satisfactory for the administration of supplemental iodine and is becoming generally adopted in goitre- prone areas throughout the world with the active encouragement of the World Health Organisation (WHO).

Salt is mainly produced by two procedures:

1) Solar evaporation of sea water in kyaris.
2) Evaporation of sea brine (saturated salt solution) in vacuum evaporation.

The latter has the advantage of producing salt with highest ercentage purity. Therefore, we produce iodized salt using multiple ffect evaporators. We have the unique plant for production of dized salt in our country.

The basic concept of using this procedure actually emanated om solving the perennial problem of acute water crisis prevailing in is barren and drought-prone land of Okhamandal region of urashtra. The main constituents of brine are water (77 to 78%) and

salt (21 to 23%). In this process, sea brine is evaporated in multiple effect evaporators to produce 5 to 6 lac gallons of pure water per day, alongwith vacuum salt. This condensate is vital for our soda ash industry in the absence of other natural sources of fresh water. This way we also conserve the ground water of this region.

Taking into consideration the undesired effects of iodine deficiency disorder among rural population, our chairman Shri D S Seth, a great visionary, voluntarily implemented the idea of iodizing salt since 1984, even before the Government made it mandatory for all salt manufacturers to do so.

We use potassium iodate (KIO_3) for iodizing our salt. It is more stable compared to potassium iodide (KI). For homogeneous mixing, solution of potassium iodate is sprayed to high speed salt separation device, which further gets mixed by means of passing through conveyers and dryers.

Presence of iodine in salt can be confirmed by the following qualitative test.

Take 5 to 10 gms. of salt sample. Add 3 to 4 drops of hydrochloric acid or sulphuric acid, 3 to 4 drops of 10% potassium iodide solution and a few drops of starch solution. It will give violet to black colour if iodine is present in the sample.

For quantitative analysis, take 20 gms. of salt sample. Dissolve it in 100 ml. of distilled water. Add 1 : 3 sulphuric acid or hydrochloric acid to acidify it. Add 10 ml. of 10% potassium iodide solution. Titrate liberated iodine against 0.005 normal sodium thiosulphaate solution using starch as an indicator.

Iodine ppm = 5.29 X ml of sodium thisulphate soln. used

At our manufacturing level, we maintain minimum 30 ppm of iodine in salt and 15 ppm at consumers level in accordance with the P.F.A Rules.

3. AN INVENTORY OF SALT CONSUMPTION IN BARODA AND BHARUCH DISTRICTS.

(ICMR multicentric study, 1986)

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Salt consumption pattern in the country varies in different parts of country, Hence the present multicentric project was undertaken to collect data about salt consumption pattern all over the country.

General objectives : To study the salt consumption profile in different parts of the country.

Specific objectives : i) To study the per head daily consumption of common salt in different seasons of the year in cooking and on plate. (ii) To study what are the types of salt preferred for cooking and other edible purposes and why. (iii) To study the cost and source of procurement of salt in rural areas. (iv) To study the time interval between salt procurement and its use.

Methodology

Selection of area : A total of 4 PHCs (two from each district) were selected at random. The PHCs selected were : (i) in Baroda district PHC Tejgadh and Tilakwada. (ii) in Bharuch District PHC Kora and Dediapada. In each selected PHC seasonal survey was carried out in total 5 villages.

The survey was carried out in three different seasons. Rainy (July - October), winter (November - February) and summer (March - June) having randomly selected 5 villages covered under each PHC. Total no of 100 households were surveyed in proportion to the population of each village.

Results and Discussion :

Household Survey :

It was observed that there was no obvious difference in salt consumption pattern in either stratum or season wise. Hence the results have been summarized on the pooled data of responses obtained from both the survey areas in 3 different seasons. During 3 seasons, out of 1200 houses, 1003 were in Plain stratum and 197 were in the coastal. As evident from the test, in Bharuch district only

iodized salt was consumed as it was compulsory.

In plain stratum, majority belonged to the tribal population. Average family size was higher in tribal than in non tribal population. Villages surveyed for coastal stratum were under PHC Kora (district Bharuch). All the households here were of non tribal population.

Crystal salt either plain or iodized is consumed by all the inhibitants of rural areas. Very few people who were service goers in the villages were using powdered salt. In general, it was also observed that few households were using salt for animal consumption. Only crystal salt was being used for animal consumption.

It was found that average quantity of salt either for human or animal consumption did not show any variation within the season or stratum. It is evident that average monthly consumption of salt is between 2.00 to 3.99 kg. in the majority of the household surveyed. The average per capita consumption of salt is found higher in the range of 2-3.99 kg. and 4-5.00 kg. than that of the other range.

Not much difference was found in the average human consumption of salt per household in all the 3 seasons in both the stratum. However, it was found that in plain stratum the average animal consumption per household was much higher in rainy season. In coastal stratum, it was much higher in winter season.

It was observed that average 2-4 kg. of salt was consumed by the majority of the household and average quantity/household was more or less similar for this particular group.

The price of salt was between Rs. 0.25 to Rs. 1.50 per kg. The price of iodised powder salt was almost double than that of ordinary crystal salt (0.26-0.50). This could be one of the reasons for using crystal salt in the villages. In coastal stratum it was observed that due to local salt production, people were getting free salt in some of the villages surveyed .

It was observed that salt was purchased either from village shops or from outside the village. However the proportion of people procuring salt from the village shops was much higher than that of salt procuring from outside the village. Very few were procuring salt by barter system. Local production of salt was found in few villages surveyed for coastal stratum in PHC Kora.

It was observed that villagers procured the salt from outside the

villages within the range of 1 to 5 kms. Majority of the households procured the salt either monthly or once in 10-12 months only. Price range did not vary either with the frequency or with the quantity of salt procured each time. It was found that salt was available throughout the year in both the districts.

Majority of the people buy salt in small quantity and carry it in the loose form. Powdered salt was generally carried in packets only. Either earthen or plastic containers were used by majority of household for keeping salt, irrespective of the season. Mode of the use of salt was direct in almost all households. Very few used the salt after grinding the crystal salt.

Shopkeeper's Survey :

This schedule was administered to all shopkeepers in survey area. During the survey, 128 shopkeepers were interviewed in both districts. Out of them, majority shops were grocery shops. Very few shopkeepers used to get salt through agency while the others procured salt from nearby town.

Crystal salt was being sold by majority of shopkeepers in both the PHCs of Baroda District and in Kora PHC of Bharuch District, While iodised salt was being sold in Dediapada PHC survey area of Bharuch District. Powder salt was sparingly available.

Most of the shopkeepers used to procure more than 100 kg. salt and used to store it in open areas at large except in the rainy season. During that period the salt was kept under cover to protect from rain.

It was found that irrespective of the salt type, the consignment of salt was monthly and quarterly. However, most shopkeepers used to store salt in open area except for rainy season. As the powdered salt was expensive in the range of Rs. 1.00 to 1.50 per kg. and the crystal salt in the range of 25 np to 50 np. shopkeepers used to sell crystal salt. The selling rate used to vary according to the type of salt i.e. crystal or powder irrespective of the quantity procured of either type.

EXPERT / GUEST LECTURES

1. SOCIAL AND ECONOMIC ASPECTS OF IODINE DEFICIENCY DISORDERS CONTROL PROGRAMME IN INDIA.

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Economics of Salt Iodisation

Economic analysis focusses on the efficient use of the resources so that societies can maximise the impact of available resources. This in health care sector consists of comparing two or more health interventions in terms of their cost and consequences. Two features characterise an economic evaluation; first it deals with both inputs (costs) and outputs (outcome/consequences) and secondly, it concerns choices. Economic analysis seeks to identify one set of criteria that may be useful in deciding among different uses for limited resources. A cost-benefit study of iodine supplementation program in India is presented.

The main strategy adopted in India for controlling IDD is by salt iodisation programme. Thus, if an economic analysis of IDD and its control is carried out, the cost would be the cost of salt iodisation programme. The benefits could be the prevention of different consequences of IDD. Monetary value is assigned to the effects of IDD prevention.

The cost of the salt iodisation programme includes capital cost (land and building, iodisation plant and equipment) amortised over the life of the plant and operating cost (Potassium Iodate, Labour, supervision and administration, maintenance and electricity). In this analysis, the costs of monitoring and information, education and communication (IEC) campaign are excluded. In addition, the analysis assumes that the current pattern of transportation and distribution of iodised salt is unchanged.

The calculations are based on the following assumptions :

1. Total requirement of iodised salt for the country is five million tons (6Kg./person/year);
2. Production capacity of iodised salt per plant is 25 tons per day and that they would work for 160 days in a year; and
3. A discount rate of 10% per annum.

Since all the capital costs are incurred at the beginning of the ogramme, they are amortised over a period of years. The total nual cost of the programme (amortised capital cost + operating st) is estimated at Rs. 1.3 billion.

nsequences of the IDD control programme

Iodine deficiency in a community affects both the human as ll as the livestock population. The consequences related to human pulation are mainly three namely health effects, change in ources use and quality of life. The health effects include morbidity the form of goitre, cretinism, mild motor and mental impairment d mortality (still births and abortions). The changes in resource use lude the costs averted by the management of IDD and oductivity gains, which in fact are savings in lost work time. In dition, a benefit that is not quantifiable is the improvement in the ality of life of patients and their families as a result of IDD evention in the community.

In addition to the above, there are consequences related to ucation in the form of reduced absenteeism (increased utilisation) d potential for better scholastic achievement. Benefits of control of ine deficiency in live stock include increase in live births and birth ight and reduced deformities. This will result in higher output of ious animal/dairy products and higher animal work output. wever, the present analysis does not include the consequences ated to the education and livestock population. Confining the nomic analysis to humans would result in an underestimation of nefits of IDD programmes.

An epidemiological model has been developed which relates l goitre rates to more important iodine deficiency disorders - inism, mild motor and mental impairment and still births and natal death. For the calculations of IDD load in India, using this demiological model, and assuming the life expectancy to be 60 rs and the crude birth rate to be 33 per thousand population, 00 new cases of cretinism, 126,000 new cases of mild mental and tor impairment and 102,000 still births and abortions would be vented each year by the implementation of an effective salt sation programme.

The calculation of costs of management of IDD is based on the owing assumptions :

1. Only 10% of affected people seek health care;
2. Only people with Grade - II goitre (Goitre visible with neck in normal position) seek treatment;
3. Costs of treatment of goitre include physician costs and cost of treatment with thyroxine; and
4. Endemic cretins will visit a health facility only once in their life time and no treatment is available for them.

Therefore, only costs of physician time are included.

Based on the above assumptions, the total cost of management of patients with IDD is Rs. 350 millions, of which Rs. 348 millions is for management of goitre.

Loss of productivity is based on the following assumptions :

1. Cretins have 55% less productivity compared to a normal unaffected adult;
2. A person having mild mental and motor impairment will have 5% less productivity.
3. For severely impaired cretins a full time care giver will be needed;
4. The minimum wage per person is Rs. 16 per day. Number of working days in year is 183 days and 90% of the population in 15-59 years age groups is engaged in productive work.

Based on the above assumptions, the total productivity loss averted as a result of an effective salt iodisation programme is estimated to be Rs. 3.9 billion (Rs. 1.7 billion each for endemic cretins and care givers of severely affected cretins. The recoupment of productivity loss by averting mild IDD would be Rs. 0.5 billion).

The cost of salt iodation programme is Rs. 1.3 billion and benefit of salt iodation programme in terms of productivity loss averted and on management of IDD is Rs. 4.25 billion (Rs. 3.9 billion + Rs. 0.35 billion). The cost benefit ratio is, therefore 1 : 3. This is a conservative estimate since it does not take into account benefits related to educability, livestock population and assuming that only 10% of the people with Grade II goitre seek health care services. Therefore, on the basis of economic analysis, it is worthwhile to have a salt iodisation programme in India. IDD control programmes justify higher health priority at the national, regional and global level.

Social and cultural aspects of IDD

The social and cultural aspects of IDD in India can be broadly classified as those related to the salt production and distribution, and those related to the community. The big crystal salt produced in India constitutes 15% of the total salt production in India. This variety of salt which is known as "baragara salt" is consumed in the hyperendemic states of Uttar Pradesh and Madhya Pradesh and neighbouring states in north and west India. Due to the large crystal size, the iodisation is not uniform in these crystals. The salt producers located in these areas harvest the salt crop less frequently so that they get the same yield with fewer trips of the labourers who have to be transported in the desert over distances ranging from 50 to 100 km.

The packaging of salt is still being done in 75 kgs. bags instead of 50 kgs. bags, even though there is a recommendation from the International Labour Organisation. The retail salt traders keep the salt bags outside the shop and this results in loss of iodine as a result of humid conditions and direct exposure to the sunlight.

At the community level, IDD is not perceived as a health problem. In fact, there are interesting socio-cultural connotations associated with IDD. For example, women in certain regions design ornaments for their goitrous necks. The appearance of goitre in pubertal girls is considered as the right time to get them married and the birth of a cretin is attributed to "Sins in the previous birth and God's will".

Many communities prefer big crystal salt for they use it as a medium for grinding spices. Some communities have the habit of washing salt before it is used for cooking, a practice which results in loss of iodine. These social and cultural practices pose a major challenge to successful implementation of salt iodisation programme.

Conclusion

Economic analysis clearly establishes the cost benefit of the IDD control programme in India. However, it is critical to address social and cultural issues for effective and sustainab'e implementation of the programme.

2. "UNIVERSAL SALT IODISATION COMMITMENT AND CHALLENGES WITH SPECIFIC REFERENCE TOGUJARAT"

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No state in India is free from the ill effects of IDD. and iodisation of salt is the most suitable, long term and sustainable solution to prevent it. The country needs to produce and distribute 5 million tonnes of iodised salt per year. The present production stands at about 3 million tonnes per annum as against the installed annual iodisation capacity of 6.6 million tonnes. The production and demand of iodated salt can be increased once all the state governments ban the sale of other than iodated edible salt and enforces the ban strictly.

MAGNTITUDE OF THE PROBLEM

India is one of the major endemic iodine deficiency countries in the world. Universal iodation of salt - which is both a preventive and a corrective measure for iodine deficieny - is a vital necessity in India today.

The most common and visible ill-effect is goitre - an abnormal swelling in the neck. A more serious condition affecting millions of iodine deficient children include mental retardation, muscular disorders, etc. In pregnancy, iodine deficiency causes abortions, still births and infant deaths.

IDD also affects livestock by reducing their milk, meat, egg and wool yields. Cattles fed with iodised salt produce milk rich in iodine. Therefore, universal salt iodation has a significant effect on human development and the quality of national resources.

CURRENT STATUS OF BAN NOTIFICATIONS

The overall annual production of common salt in the country is approximately 13.5 million tonnes. Human and animal consumption accounts for 5.2 million tonnes with the balance used for the requirements of heavy chemical industries such as caustic soda and soda ash and other non-edible purposes such as tanning, water softening, refrigeration, soaps and detergents, exports and reserve stock. The salt producing areas of India are located primarily in the

States of Gujarat, Tamil Nadu, Rajasthan, Andhra Pradesh, Maharashtra, Orissa, Karnataka and West Bengal. At present, in the three major salt producing States (Gujarat - 68%, Tamil Nadu - 15% and Rajasthan - 12%) a complete ban order on sale of non-iodised salt has been issued. Tamil Nadu State Government only recently initiated significant steps towards the goal of universalisation of iodated salt and issued the ban notification effective from 1st January, 1995.

IODISED SALT AND THE PFA ACT AND RULES

Iodised salt is considered an essential food item. Under the provisions of article 15.01 of Appendix B of the Prevention of Food Adulteration (PFA rules, 1954) Act, the standards of quality specified for iodised salt are as follows :

Iodised salt means a crystalline solid, white or pale pink or light grey in colour, free from visible contamination with clay, grit and other extraneous adulterants and impurities. It shall conform to the following standards, namely:

1. Moisture	:	Not more than 6.0% by the weight of the sample.
2. Sodium chloride	:	Not less than 96.0% by weight on dry basis.
3. Matter insoluble in water	:	Not more than 1.0% by weight on dry basis.
4. Matter soluble in water other than sodium chloride	:	Not more than 3.0% by weight on dry basis.
5. Iodine content at	:	
a. Manufacturer's level	:	Not less than 30 PPM on dry weight basis.
b. Distribution channel including retail level	:	Not less than 15 PPM on dry weight basis.

LABELLING OF IODISED SALT

All bulk and consumer packing of iodised salt must carry a label containing the following information as per the provisions of Rule 32 of PFA rules, 1954, Section 39, Rule 4 and 6 of the Standard of Weights and Measures Act, 1976 and the Standard of Weights and

Measures (Packaged Commodities) Rules, 1977 :

- Reference to "Iodised salt".
- Name of the iodising ingredient.
- Name and full address of the manufacturer.
- Iodine content of salt.
- Batch number.
- Month and year of manufacture.
- The maximum retail price (inclusive of all taxes).
- The net weight.

All iodised salt producers and repackers are required to ensure that the salt marketed by them conforms to the standards prescribed under the provisions and rules of the Prevention of Food Adulteration Act (PFA), 1954. In addition to these, all iodised salt producers/repackers are expected to print the 'Smiling Sun' logo on the iodised salt package for easy identification by consumers.

ENFORCEMENT OF THE BAN

Strict enforcement of the ban is important and essential. The PFA Act is implemented by the Food and Drugs Administration of the concerned states. The Food Inspectors are empowered to draw samples of iodised salt in accordance with procedures set out in the rules and get them analysed in designated laboratory. If a specimen fails to conform to the specifications, either in terms of its iodine content and other characteristics, the food inspectors are empowered to launch prosecutions against the manufacturers/producer/retailer/seller of such sub standard iodised salt. A successful prosecution could mean imprisonment for a term which shall not be less than 6 months but which may extend upto 3 years and a fine not less than Rs. 1000. The ban notification issued by the state governments does not specifically prohibit sale of non iodised salt for animal consumption. This leads to selling of both iodised and non iodised salt at the same premises. There is a need to widen the provisions of the ban to include salt requirements of the animal population.

Initially State Public Health Department takes a policy decision, based on goitre prevalence surveys to bring a concerned district/districts/state under the purview of the ban notification. On

eipt of directives from the state government, the food (health) hority issues a notification under section 7 (iv) of the PFA Act, 54, imposing a ban on the sale and distribution of salt other than ised salt as an item of food in the identified areas from a specified e. The notification empowers the Food Inspectors of the Food and ug Administration to draw samples from the wholesale and retail tlets and send them for analysis to the designated laboratory. On eipt of the results of the analysis, the Food Inspector imposes the osecution of those manufacturers/traders whose samples were nd substandard.

Thus, enforcement of the ban calls for developing an effective stem of checks, control and greater awareness of the range of nefits of iodised salt on the part of salt producers, wholesalers, ders, retailers and the general public.

CKING OF IODISED SALT

The packing of iodised salt for distribution is an important pect of the IDD control programme. In order to keep iodine losses a bare minimum, the packing material must be safe, protective and mpact. The recommended packing material for iodised salt are :

- HDPE bags, preferably laminated,
- LDPE pouches and
- Polythene lined jute bags.

The normal retail packing units used are 500 gms. and 1 kg. For lk packing, the units approved at present are 40, 50, 75 and 100 s.

At present there are 10,000 producers (licensed and unlicensed) common salt in India. Out of these, only 400 are registered oducers of iodised salt. However, the total number of salt nufacturers (including producers and traders) is approximately 2.

DISED SALT PRODUCTION IN GUJARAT

The iodised salt manufacturers in the state have taken a leading e in the production and supply of iodised salt since the launching the programme. Presently they are producing more than 20 lakh nes of iodated salt catering to the requirements of U.P., M.P., harashtra, Delhi, Bihar, West Bengal, Assam and other rth-Eastern states.

In order to encourage salt iodisation by Co-operative societies, 2 iodisation plants donated by UNICEF have been made available to M/s. Dharasana and Chharwada groups of salt production and sale Society ltd. of Valsad district and Sabarmati Salt Farmer's Society run by N.D.D.B. at Kharaghoda.

At present, about 10 submersion plants and 203 spray mixing plants having total installed capacity of about 33 lakh tonnes have been set up at various salt production sources in Gujarat as per details given in following page.

Since the annual requirements of salt for Gujarat is around 2.7 lakh tonnes and the production of common salt within the state is much more than the requirements, the availability of raw salt for the purpose of iodisation is not a problem. Likewise, the annual iodisation capacity created within Gujarat is around 33 lakh tonnes which again can cater to the entire requirements of the state.

PRODUCTION AND SUPPLIES OF IODISED SALT

The production and supplies of iodised salt in Gujarat of various states in the country during the last 4 years is as per following :

Production of iodised salt (in '000 tonnes)

Year	Gujarat	India	Despatches from Gujarat
1991	2153.4	2836.5	2153.4
1992	2076.5	2756.2	2088.8
1993	2131.1	2846.1	2140.0
1994	2132 9	2977.6	2052 2

QUALITY CONTROL MONITORING

Keeping in view that a considerable quantity of iodised salt is marketed by the licensed sector in Gujarat, a number of quality control laboratories have been set up at each of the following places manned by the Deputy Supdt. and a few a Chemical Assistants / Inspectors.

1. Salt Test Laboratory, Gandhidham
2. Salt Test Laboratory, Maliya
3. Salt Test Laboratory, Dhrangadhra
4. Salt Test Laboratory, Santalpur
5. Salt Test Laboratory, Bhavnagar

STATEMENT SHOWING THE CATEGORY WISE NUMBER OF UNITS PERMITTED / RECOGNISED TO COMMENCE PRODUCTION OF IODISED SALT IN RESPECT OF GUJARAT SALT REGION FOR THE PERIOD UPTO 31-03-1995.

Sr.	Area	Category I		Category II		Category III		Category IV		Traders		Total	
		P.	C.	P.	C.	P.	C.	P.	C.	P.	C.	P.	C.
1	Kharaghoda	7	172000	-	-	-	-	15	135000	29	565000	51	872000
2	Kuda/Dhrangadhra	5	95000	-	-	-	-	-	-	14	191000	19	286000
3	Gandhidham/Chirai	23	599000	2	35000	3	33000	23	255500	12	225000	63	1147500
4	Santalpur	11	174000	-	-	-	-	8	111000	2	30000	21	315000
5	Maliya-Lavanpur	16	350000	1	25000	1	25000	3	60000	3	45000	24	505000
6	Halvad	-	-	-	-	1	15000	3	43000	8	137000	12	195000
7	Bhavnagar	7	125000	-	-	-	-	-	-	2	30000	9	155000
8	South Gujarat	10	108000	-	-	1	15000	-	-	2	40000	13	163000
9	Jamnagar	4	735000	-	-	-	-	-	-	1	6000	5	79500
10	Singach/Salaya	3	76000	-	-	-	-	-	-	-	-	3	76000
		86	1772500	3	60000	6	88000	52	604500	73	1269000	220	3794000

Note : P = No. of Units

C = Permitted Capacity (Tonne/Annum)

6. Salt Test Laboratory, Kharaghoda
7. Salt Test Laboratory, Ahmedabad
8. Salt Test Laboratory, Jamnagar

The results of analysis of samples drawn from authorised salt producers during the year 1994 are as under :

STATEMENT SHOWING THE NUMBER OF IODISED SALT SAMPLES ANALYSED, FAILED IN VARIOUS SALT TEST LABORATORIES OF GUJARAT SALT REGION DURING THE YEAR 1994.

Sr. No	Name of the salt test laboratory	No. of samples analysed	No. of Samples found		Percentage of failed samples
			Below 30 ppm	Above 30 ppm	
1.	Ahmedabad	2105	231	1874	10.97
2.	Bhavnagar	3308	229	3079	6.90
3.	Dhrangadhra	4511	928	3583	20.57
4.	Gandhidham	3958	207	3751	5.20
5.	Jamnagar (Upto May '94)	182	5	177	2.70
6.	Kharaghoda	13744	4211	9533	30.60
7.	Maliya	5995	1085	4910	18.10
8.	Santalpur	6336	658	5678	10.40

POTASSIUM IODATE MANUFACTURERS IN GUJARAT

In Gujarat the following parties have set up Potassium Iodate manufacturing Plants by Chemical/Electrolysis process :

1. M/s. Anjali Chemical Industries, Rajkot
2. M/s. J. B. Fine Chemical Works, Gandhidham
3. M/s. Iodochem, Anand
4. M/s. Micron Laboratories, Wadhwan City, Surendranagar
5. M/s. Nirav Chemical (P) Ltd., Wadhwan City, Surendranagar
6. M/s. Star Chem Corporation, Patdi
7. M/s. Star Chem Industries, Patdi
8. M/s. S. & S. Pharmaceuticals, Wadhwan City, Surendranagar
9. M/s. Swastik I O Chem, Jamnagar

SALT REFINERIES IN GUJARAT

Salt department, with a view to improving the quality of salt, is granting permission liberally for setting up of salt refineries. The following salt refineries are in operation in Gujarat producing and supplying iodised salt in 1 kg./2 kg. and bulk packings in major parts of the country.

1. M/s. Tata Chemical Ltd., Mithapur.
2. M/s. Wellbrine Chemicals (P) Ltd., Gandhidham.
3. M/s. Supper Salts (P) Ltd., Jambusar.

Besides the above, more refineries are at various stages of implementation at Jamnagar, Singach, Dahej, Gandhidham Chirai, Halwad and Kharaghoda.

3. STRENGTHENING OF IDD CONTROL PROGRAMME BY REDESIGNING HEALTH INPUT

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National Goitre Control Programme (NGCP) was launched by Government of India towards the end of the Second Five Year Plan in 1962. The main components of NGCP designed were (i) initial survey to identify endemic areas, (ii) production and supply of iodised salt to the endemic regions and (iii) resurvey in goitre endemic regions after five years of continuous supply of iodised salt to assess the impact of the control Programme.

With inception of NGCP and in subsequent two decades, initial surveys were conducted by teams of NGCP, iodised salt was manufactured only under salt commissionerate and resurvey were also conducted by teams of NGCP. All these activities were concentrated in Sub-Himalayan region (goitre belt of India). NGCP was mainly looked at as an activity of NGCP teams, salt commissioner and drug controller and role of health department was not well defined.

With reports of goitre from different states (other than Sub-Himalayan regions), changing concept of endemic Iodine deficiency from endemic goitre, led to the need of coverage of widespread regions for initial and resurvey. Increasing demand of iodised salt and entry of private sector in salt iodisation also changed the situation.

Initial surveys in uncovered districts were assigned to the Preventive and Social Medicine departments of medical colleges. Funds were allotted at district health level for health education upto grassroot level. Thus decentralised activities with health departments were initiated.

Today when IDD have been reported from more than 15 states of the country with a move towards universal iodisation of salt, NGCP/IDDCP needs additional health inputs and redesigning at par with other national health programmes, fully utilising existing health network in country.

Two major fields need such redesigning (1) Teaching and

Training (2) Health Monitoring

(1)Teaching and Training :-

Teaching of IDD and its control programme is almost nil or negligible in medical colleges and foods and nutrition departments in majority states. Same is the situation with continuing education programmes for health functionaries including PHC medical officers and paramedics.

One of the major problem is that the results of initial goitre survey, status of control programme in state and results of resurvey are not disseminated to medical teachers of concerned departments (PSM, Medicine, Surgery, Paediatrics, Biochemistry, Pharmacology etc.) or to health department hierarchy. Deliberations at regional, national or international workshops or seminars on IDD never percolates upto them.

As a result of this it is realised that majority of the medical teachers and health personnels of several states of India are unaware and not convinced about the existence and seriousness of IDD problem in their areas and even the efficacy of iodised salt programme in IDD control. Naturally we cannot expect them to give due priority to IDD and its control programme in teaching and training.

(2) Health Monitoring :-

Resurvey at five years interval after supply of iodised salt is one of the weakest activity of NGCP today. Widespread endemicty, universal iodisation and changing concept from goitre to IDD will need modification in monitoring of the control programme.

Regular monitoring will be feasible only by decentralising the survey work and involvement of the health network. It is well documented that 70% of goitre cases are contributed by preadolescent, adolescent and young adults at any level of endemicity. In all the states schools and colleges now exist in remote villages and small towns. Five yearly assessment of students of such institutions only will also serve the purpose.

Emphasis has been laid down on the use of goitre grades (ob,I, II, III, IV) in instructions for district's initial survey. Identification of grade ob needs proper training and experience and even then it is highly subjective. In view of need of decentralisation, rethinking is needed to return to gradation of I II III and IV to avoid large scale

errors in monitoring.

Preventive Social Medicine Departments can be assigned sample survey programme as a part of monitoring as it is done in ICDS and UIP programme.

Recently there is a move to develop district level laboratories to monitor IDD control programme through Urinary Iodine estimation. Trace element estimation in urine that too for monitoring of programme needs trained technicians. At present hardly any district level laboratory will have such persons.

There is also a need to identify few indirect easily identifiable and easy to compile indicators of IDD in monitoring of programme in addition to clinical resurvey and urinary iodine estimation.

A school based study of deaf-mute students done by our department has revealed environmental iodine deficiency as most important environmental causative factor which contributed to about 30% of total deaf-mutism. Regular reporting of deafmutism in preschool children can thus be used as an indirect indicator.

Monitoring of benefit and safety of iodised salt programme can be done by identifying sentinel centres. Two or three centres located in different regions of the state already doing thyroid function tests can be designated as sentinel centres. A report of total new cases screened and break-up of the same (euthyroid, hypothyroid and hyperthyroid) can be collected every year from these centres. Statewise and nationwise compilation of such reports will show the pattern and changing trend of thyroid disorders over a period of time which can be related with iodised salt programme.

Thus it is opined that additional and redesigned health inputs will be needed for successful sustainable IDD programme in this country with following summarised steps.

(1) Teaching and Training :-

- Organisation of state level workshops and seminars for medical teachers of concern departments, and district health officers,
- Organisation of district level training cum awareness camps for PHC medical officers and paramedical workers.
- Organisation of taluka level health education programme for grassroot level workers.

- State or district level training programme for laboratory technicians for urinary iodine estimation.
- Training modules, audio visuals and uniform schedules should be structured for standardised uniform appropriate message reaching to every one.

2) Health Monitoring :-

- Decentralisation with involvement of health network and medical colleges.
- Concentrating on preadolescent, adolescent and young adult groups in resurvey.
- Avoiding grade 'ob' in resurvey.
- Proper planning of iodine monitoring laboratory in phased manner after manpower development.
- Childhood deafmutism reporting by health net work.
- Development of sentinel centres to observe trend in thyroid disorders.

BASIC SCIENCES AND MISCELLANEOUS

1. IODINE - SOURCE, ABSORPTION AND METABOLISM

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Iodine is present in the environment in limited quantities compared to the amount needed for normal thyroid hormone production. As a consequence there is a highly efficient mechanism for accumulation and conservation of this element by the thyroid.

Plants extract iodine from the soil and return it to the soil unless they are trapped. Iodine is added to the atmosphere by photo-oxidation of the iodine in sea-water and falls to the earth with rain and sea-mists where it is retained by the soil and plants.

Vegetables and fruits grown and obtained from sea-shore and also sea-fishes are rich in iodine. Vegetables and fruits in hilly regions lack iodine.

Absorption and Metabolism

Iodine is rapidly reduced in the gut to iodide and is rapidly absorbed by the stomach and upper small bowel. Although all of this iodide eventually appears in the thyroid or in the urine; there is an active internal circulation of iodide in many other sites. In the alimentary tract iodide is secreted by the salivary glands and the gastric mucosa.

The lactating mammary gland also secretes iodide and is an important route of iodide loss from the mother and for intake by the nursing infant. In some species the placenta actively transports iodide from mother to foetus. The ciliary body of the eye and the choroid plexus of the central nervous system transport iodide towards the plasma.

Iodine incorporation in thyroid gland for synthesis of thyroid hormones.

I. Iodine Trapping : The thyroid concentrates iodide by "actively" and "selectively" transporting it from the circulation to the colloid. The transport mechanism is called as "iodide trapping" or "iodide pump".

The trapping is done against electrical gradient and concentration gradient. As it is "actively" taken in against

electrochemical gradient, it is energy dependent and requires energy.

II. Oxidation of Iodide : Oxidation of iodide and other is catalyzed by a "beme containing" peroxidase called thyroperoxidase which requires H_2O_2 for its activity.

Oxidation of Iodide to active iodide formation involves two distinct steps.

i) Production of H_2O_2

ii) Oxidation of iodide by the "peroxidase" enzyme in presence of H_2O_2

III. Iodisation of Tyrosine : Active iodine transfers iodine from its iodide - binding site to a tyrosine residue of the enzyme bound thyroglobulin under the influence of thyroperoxidase enzyme.

Iodination of the tyrosine residue in thyroglobulin occurs first in "3 position" of the aromatic nucleus forming monoiodo tyrosine (MIT). Monoiodo tyrosine is next iodinated in the position 5" to form "Di iodotyrosine" (DIT). Normally, the two are present in approximately equal concentrations but with iodine deficiency more MIT is formed.

This process of iodination, called as "Organification" occurs within seconds in luminal thyroglobulin, Once iodination occurs the iodine does not readily leave the thyroid.

IV. Coupling of Iodotyrosine : Two molecules of DIT when undergo an oxidation condensation, under the influence of the enzyme thyroperoxidase forms Thyroxine (T 4) molecule still in peptide linkage. In the process an "alanine" residue is liberated, which ultimately forms pyruvate and ammonia. Similarly triiodothyroxine (T3) is probably formed by condensation of MIT with a molecule of DIT or vice versa. The condensation reaction is an aerobic and energy requiring reaction. Tri-iodothyronine (T3) may possibly be formed also by "partial de-iodination" of T4.

Approximately 20% of the thyroglobulin tyrosine residue are iodinated. Only 8 - 10% of the total tyrosine bound iodine in the thyroid is in the form of thyroxine (T4), most of this is found as DIT

or MIT only traces of "reverse" T3 and other components are present. Thyroid stimulating hormone (TSH) stimulates the synthesis of thyroglobulin and all the steps from oxidation to coupling reactions for forming thyroid hormones.

Excretion :

Renal iodide excretion is important and the urine is the major route by which iodide is lost from the body. This behaves like a passive process except when the excretion of chloride is very low. Thus, variation in renal iodide clearance which occur in renal disease, in thyroid disease and as a normal diurnal variation are mainly due to changes in glomerulor filtration. Renal iodide excretion comes not only from ingested iodine, but also from iodide arising from the thyroid iodine "leak" and from the metabolism of the thyroid hormones, because all of these enter a common extra thyroidal iodide pool.

2. IODIZED SALT : A PRACTICAL SOLUTIN FOR IDD

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Recognition of prevalance of I D D in the various communities led to theconcept of aplying the programmes to tackle this problem. Understanding of the biochemistry of thyroid hormones and the role of iodine in maintaining euthyroid state gives a logical step to supply iodine to the vulnerable population. Iodine can be supplied in the form of iodide or iodate of sodium or potassium. From the point of covering the large population, addition of iodine to bread or salt is considered practicable. Common salt can be iodized by iodides or by iodates. Daily requirement of iodine is about 100-150 micrograms. This can be supplied through 10-15 grams of commonsalt which is usually consumed daily. Amount of iodides and iodates required to supply this much iodine can be easily administered without any special problem. Apprehension of toxicity of iodates is unfounded. Administration of a single dose as high as 850 mg of potassium iodate in some diagnostic procedure has been without any harmful effect. This dose is much higher than one which is supplemented through iodised salt the concentration of iodate in salt is standardized as 25 PPM meaning that in 10 gm of salt iodate concentration is 250 microgram which is equivalent to 150 microgram of iodine. Only logical toxicity would be in the form of thyrotoxicosis. Such a report is there from Tasmania when potassium iodate was added to bread. Iodates are less soluble and are more staable. Thus iodides and iodates may be considered same. Ease and cost of iodization by iodides or iodates may be of practical value rather than the fear of toxicity with agent.

3. ROLE OF FOOD IN IDD

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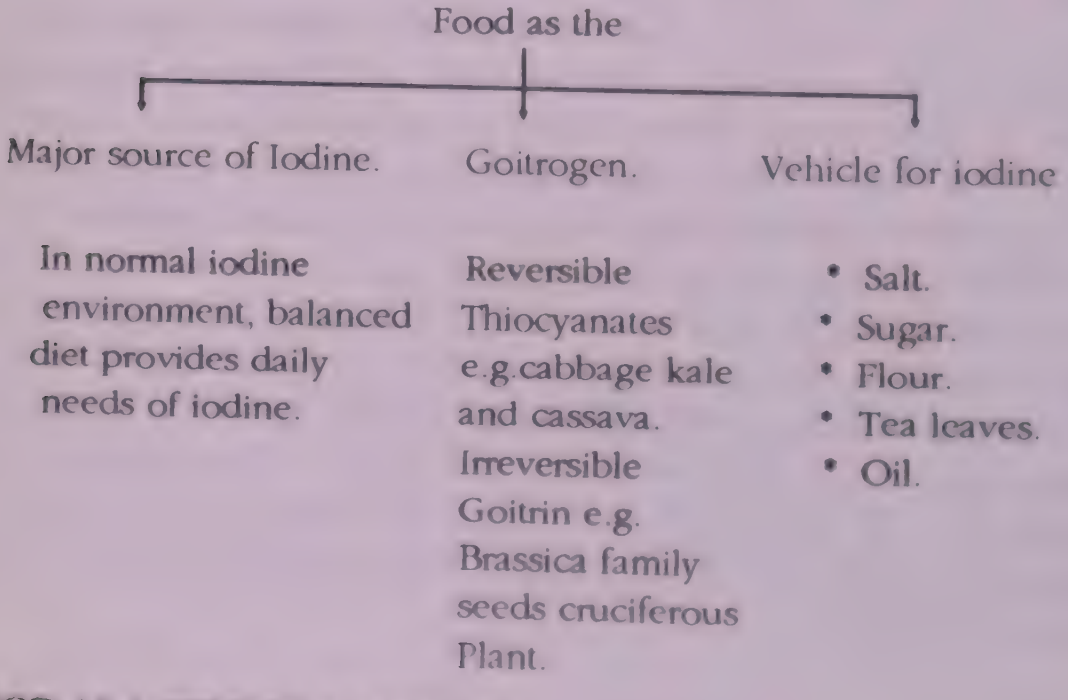
Generally, balanced diets provide sufficient amount of vitamins and minerals but in disturbed environmental situation the diet may lack some of the important nutrients and iodine is one such nutrient. As food is the major source of iodine , an attempt is made to evaluate the role of food in I D D. About 90% of iodine is obtained from the food. Therefore food plays an important role in I D D. Food in I D D is evaluated from three major angles which is presented in figure 1

FIGURE : I (FOOD IN IDD)



FOOD AS A SOURCE OF IODINE :

Iodine content of plant food is low compared to animal food. Most terrestrial plants have low iodine content averaging 1 mg/kg dry weight. Sea foods are rich in iodine. Variations in iodine content of different kinds of food articles is shown in Table 1.

TABLE: I

Iodine content of food articles.

Food Articles.	No.*	(microgram/100g)** Iodine content
Cereals & Millets	7	13.6 - 73.0
Pulses & Legumes-wholegrains	12	10.0 - 56.0
Dals	5	13.0 - 52.0
Leafy vegetables	12	2.7 - 20.0
Other vegetables	8	1.4 - 4.6
Roots & Tubers	5	2.0 - 17.0
Nuts & Oilseeds	11	35.0 - 54.0
Spices & condiments	18	6.0 - 96.0
Other seeds	6	13.0 - 102.0
Fruits	6	3.0 - 12.4
Milk & Milk products	5	7.1 - 96.0
Eggs & products	4	36.0 - 86.0
Fish (Dry)	2	88.0 - 187.0
Prawn dehydraked powder	2	80000 - 11500

(Source : Karmarkar et al, 1990)

* number of different food stuff analysed from a given group.

** fresh wt. basis.

Wide range in iodine content is observed in different food groups. Samples of even the same food articles have shown wide variation in their iodine content. It is seen that food of animal origin have high or level of iodine than that of the plant origin.

Regional Variation in Iodine content of Food Articles :

Iodine content of different food articles of different regions is summarized in Table-II which also highlights the fact that the iodine content of the same food articles show interstate as well as intra state variations.

TABLE-II

REGIONAL VARIATIONS IN IODINE CONTENTS (Mgm/100 gm dry weight) OF FOOD ARTICLES

FOOD ARTICLES	HYDERABAD A P	INDUKURUPETA A P	JABALPUR M P	GUWAHATI ASSAM
RICE MILLED	36-48	20.8	3.8-15.3	34.9
RICE UNMILLED	---	11.1	6.6-7.6 (18.3-43.3)	----
WHEAT	26-34	----	5.1,32.7	----
MAIZE	32-34	25.0	6.0-15.0	----
KADO	19.0	57.0	----	----
BAJRA	12.5-42	26.7	----	12.4
SORGHUM	53.0-85	20.0,13.3	----	----
RAGI	9-19	31.1	----	----
OTHER MILLETS	----	20.0, 13.3	9.1,0.8,21.2 28.2,30.3	----
AMARNATH SEEDS	73-86	----	6.4	
GROUND NUT	34-63	14.4	----	----
SESAME	43	29.2	----	----
SOYABEAN	49	----	4.4	----
BENGALGRAM	33	----	----	11.6-14.9
BLACKGRAM	48	22.2	6.0-28.2	10.3
GREENGRAM	25-26	31.1	----	----
HORSEGRAM	26.0	17.4-23.3	----	----
RED GRAM	26.0-30.0	16.8-20.8	----	20.4
LENTIL	13.0	-----	----	4.1
COWPEA	39.0	21.6-25.0	----	----
AMARNATH LEAVES	130-170	97.8	8.2-36.0	----
CUCUMBER	----	36.6	----	4.0,6.4,28.2

(Source Karmakar et al, 1990)

Goitre Prevalence Rate in Relation to Regional Food Consumption :

Study reveals that food grown in region with iodine deficiency

in soil and water, contains low iodine. Families of such regions entirely dependent on locally grown food, are likely to suffer more from IDD than those consuming (partly or totally) food grown in normal iodine environment. Same is shown in table No. 3 from a of study in tribal area of Surat district.

TABLE :III

GOITRE PREVALENCE RATE IN TRIBAL POPULATION IN RELATION TO FOOD CONSUMED.

SR NO.	SOURCE OF FOOD.	POPULATION EXAMINED	GOITRE PREVALENCE RATE (%)
1.	Local	1424	34.6
2.	Mixed	1654	30.4
3.	Non Local	1266	30.5
	Total :	4344	31.39

(Source : Jagirdar, 1986).

Value of Z test
between 1 & 2, Z=2.3 (Significant)

between 2 & 3, Z=0.1 (Not-significant)

between 1 & 3, Z=2.5 (Significant)

It shows that goitre prevalence rate was significantly higher in population consuming entirely locally grown food.

LOSS OF IODINE FROM FOOD DURING COOKING :

Iodine is vulnerable to moisture and heat. Loss of iodine is observed during cooking. Loss is maximum in boiling and is minimum in roasting. (table No. 4)

TABLE : IV

LOSS OF IODINE DURING COOKING

Method of cooking	Mean Loss	
	Goindi et al 1993	Harrison et al 1965
Pressure cooking	22	---
Boiling	37	58
Shallow frying	27	---
Deep frying	20	20
Roasting	6	---
Steaming	20	---
Grilling	---	23

Higher loss during boiling can be attributed to the fact that iodine is volatile and gets evaporated during boiling.

FOOD AS A SOURCE OF GOITROGENIC SUBSTANCES :

Goitrogens are the substances capable of producing goitre by interfering with the normal functioning of the gland. There are two types of goitrogens present in the diet, namely Thiocyanates and Goitrin.

SOME STUDIES OF FOOD GOITROGENS :

Usually goitrogenic substances dominate when food is low in iodine and sometimes it is seen that food articles low in iodine content have high content of various goitrogenic substances. Table-V indicates iodine content of the foods. Amount of goitrogenic substances in the same food are higher in goitrous area than non-goitrous areas. Higher amount of thiocyanate is present in milk, which depends upon the type of the food and goitrogenic substances present in the cattle food. (Table-VI)

TABLE : V

GOITROGEN IN FOOD ARTICLE

Food Article	Iodine content of food items		Thiocyanate	Content of food	
	Goitrous	Non-Goitrous	Goitruos	Non-Goitrous	"t" Value
Wheat	0.21+/-0.38	0.28+/-0.43	1.20+/-0.15	1.17+/-0.28	0.72
Redgram (dal)	0.56+/-0.16	0.64+/-0.036	----	----	----
Tomato	0.59+/-0.021	0.65+/-0.043	----	----	----
Sponge Gourd.	0.85+/-0.47	1.02+/-0.014	3.89+/-0.63	2.38+/-0.19	6.97 ***
Potato	1.35+/-0.016	----	----	----	----
Okara	----	----	3.3+/-0.43	2.66+/-0.40	1.57
Cow's Milk	----	----	2.33+/-0.14	1.62+/-0.17	7.46 ***
Buffalo	----	----	2.0+/-0.13	1.48+/-0.24	4.14 **

** P < 01 *** P < 001

(Source : Agrawal et al, 1988).

Organic matter containing bacteria present in water is known to produce goitre either by bacterial infection or the toxin produced by them. It has been observed that :

- "Iodine deficiency must act in conjunction with other goitrogenic factors to produce a goitre endemia".
- "Environmental goitrogens may normally be ineffective when low in concentration, but may become significant when the supply of iodine is restricted".

TABLE : VI

GOITRE ENDEMIA ATTRIBUTED TO ENVIRONMENTAL GOITROGENS

Locality	Source	Vehicle	Active Principle
Tasmania	Grass & Weeds	Milk	Isothiocyanate
Finland	Grass & Weeds	Milk	Thioglucoside Goitrin.
Nigeria	Cassava	----	Thionamide-like Goitrogen
Idj-Wi-Island	Cassava	----	Cyanogenic glucoside (Thioaganate)
Chile	Pinion-nut	----	----
West Virginia	E.Coli.	Water	5.10×10^4 (mo.wt)
Greece	E.Coli	Water	----
Colombia	Sedimentary rock	Water	Sulfurated hydro-carbon (disulfides)

(Compiled by Gaitan, 1985)

FOOD AS A VEHICLE FOR IODINE SUPPLEMENTATION :

Different food sources like salt, sugar, flour, tea- leaves, oil have been tried as a vehicle for iodine supplementation.

Characteristics of vehicle and choice of vehicle :

Important characteristics of vehicle and fortifying agents are as follows :

Qualities of vehicle :

It must be universally available and acceptable. Its use should not be influenced by age, sex, socio-economic status, geographical zone or region and season and it should be cheap and easily available.

Qualities of fortifying agents :

It should be chemically safe and stable in food after addition and cooking. It should not change the colour and taste of preparation. It should be easily available and so also the technology of fortification.

As far as the selection of vehicle for iodization is concerned,

looking to the geographical condition and socio- economic status of Indian population, salt is the vehicle of choice and KIO_3 is the fortifying agent in use.

Salt consumption and variation in iodine content of different brands of salt :

It is reported that majority of the people consume nearly 10 gm. of salt daily. Solanki (1986) reported that Salt intake is almost uniform among various communities. Intake pattern in his study is summarized in Table - VII. Significant difference is observed in amount of salt consumed by urban, rural and tribal populations.

TABLE : VII

MEAN SALT INTAKE (gm per consumption unit per day) in 1134 families

Salt Intake (gm)	Urban (N=333)	Rural (N=346)	Tribal (N=455)	Total (N=1134)
Mean	9.2	11.8	10.1	10.4
S.D.	4.6	5.3	4.5	5.9

(Source : Solanki, 1986)

This study was conducted during the same season in urban, rural and tribal areas. Results indicate that mean salt intake ranged from 9.2 to 11.8 per consumption unit per day in these groups.

Variation in Iodine content of salt :

As per the ISI specification of 1988 the iodine contents of iodized salt should be minimum 30 ppm. Iodine content of iodized salts are found in variable amount in different brands of iodized salt (Vali et al, 1993). Iodine contents of different salts are presented in Table-VIII.

In contrast to this, Kapil et al (1993) has reported low level of iodine in most of the samples of iodized salt. Inadequate amount of iodized salt is produced in state of Himachal Pradesh as 59% of crystalline and 34% of powdered salt samples had an iodine content less than 15 PPM.

TABLE : VIII

Variation in iodine content of salt

	Type of salt	Brand	Iodine content (PPM)
1.	Ordinary	Cow	2.2
2.	Iodized	Tata	42.3
		Shree Laxmi	34.7
		Snow	21.5
		Flamingo	42.7

(Source : Vali et at, 1993)

Effect of storage on Iodine content of salt :

Loss of Iodine is reported during storage of iodized salt which is clearly seen from the data of table : IX.

TABLE : IX

Loss of iodine in iodized salt after storage

Specifications	Brand name of iodized salt			
	TATA	FLAMINGO	SNOW	SHREELAXMI
Date of Packing	Jan.90	Dec.89	Nov.89	Jan.90
Iodine content immediately after purchasing in PPM (Mar.90)	42.33	42.75	21.51	34.71
Iodine content after storage (7 months) in PPM	40.20	3.13	19.00	28.50
Loss of Iodine in PPM	2.13	5.62	2.59	6.21
% Loss	5.03	13.14	13.65	21.76

(Source : Vali et at, 1993)

Loss of Iodine is observed in all the iodized salts. The % loss is found to be different in different brands of iodized salt. The method by which the salt is iodized may be responsible for loss of iodine during storage.

Effect of cooking on Iodine content of food cooked with iodized salt :

Loss of iodine during cooking is reported by Vali et al (1993). The loss of iodine is higher in the diet which is cooked using iodized salt than cooked with non-iodized salt.

A 14% decrease in iodine content was observed due to cooking raw diet without use of salt while a 15% decrease in iodine content was observed in diet cooked with ordinary salt and 35-66% loss was reported in the diet cooked with iodized salt. It implies that iodized salt which is in the iodate form is less stable as compared to iodine in food stuff. Even method of cooking, heat and moisture used during process and preparation of diet affect the iodine content of the food.

Limitation and Need for Exploration :

Very few studies on iodine content of food articles and the effect of cooking on iodine are available in this country. This is more true for study of goitrogen in food. Regional studies on food iodine content, goitrogens, iodized salt acceptability and their role in I D D on some epidemiological design and methodology are urgently needed.

4. DETECTION OF IODINE DEFICIENCY

(Source : Dunn and DerHar, 1990)

A. Background

The first question to ask is whether iodine deficiency exists in a particular region or population, and if so, how severe it is.Often the likelihood of iodine deficiency in a given region can be predicted from knowledge of its geographical location.

Goitre is usually the most obvious sign of iodine deficiency, but brain damage, mental retardation, miscarriages, and child mortality are more serious consequences. It is, therefore, important to document the goitre prevalence in a population to determine whether these more serious consequences are likely to be present or not.

The two most valuable means for assessing the severity of iodine deficiency in a given area are:

- the prevalence of goitre, and
- the urinary excretion of iodine.

B. Goitre surveys

For examination of children or adults, the examiner stands or sits facing the subject, places his two thumbs on either side of the subject's windpipe several centimeters below the notch of the thyroid cartilage (the "Adam's apple") and rolls his thumbs gently over the thyroid, which lies next to the windpipe. This technique is called "palpation".

The very first decision should be whether or not the subject has a goitre. If each lobe is larger than the terminal phalanx of the subject's thumbs, he or she has goitre.

This classification system has been endorsed by the WHO and ICCIDD. The examiners need not be medical professionals, but they should be trained and initially supervised by other examiners with experience to obtain uniformity of results.

C. Urinary iodine

Almost all iodine in the body is eventually excreted in the urine. Thus measurement of iodine in the urine provides a good index of the iodine taken in. Since the absolute minimum daily iodine requirement is about 50 ug, a urinary iodine level of less than 50ug

per day means iodine deficiency. Some degree of iodine deficiency may exist even when the urinary iodine excretion is as high as 100 ug per day. When the mean daily urinary iodine excretion in an area is less than 25 ug, cretinism will frequently be found in the population.

Two general approaches have been used.One approach relates urinary iodine to urinary creatinine, and express the result as a ratio, ug iodine per gram creatinine (ug per gm cr). The other is to simply measure the concentration of iodine in the urine, as ug iodine per 100 ml urine.

A manual method requires a heating bath (oil or sand), or a furnace for ashing, a colorimeter to measure color change, and special chemical reagents, such as ceric ammonium sulfate, arsenious acid, and sulfuric acid.

The same chemical reaction can be carried out with automated equipment. The estimated cost is from $20,000-40,000. For initial surveys, it is recommended to collect and send the samples to an appropriate reference laboratory. The usual cost for doing these determinations will range from US $5-10 per analysis. Urine samples (2-5 ml) can be collected in the field, stored without refrigeration, and sent directly to the assay laboratory.

D. Other clinical and laboratory data

Additional information can sometimes be obtained from casual observation of cretinism or widespread mental retardation. Occasionally, further laboratory investigations are obtained for research purposes. While these tests can be valuable, they are expensive and difficult to obtain and are not usually necessary in a general evaluation.

1. Laboratory tests related to thyroid hormones

Laboratory methods exist for measuring blood levels of the major thyroid hormones (thyroxine and triiodothyronine) and the stimulating thyroid hormone (TSH). These are standard laboratory procedures, usually by radioimmunoassay techniques.

2. Neonatal screening

Approximately one out of every 4,000 newborns in areas without iodine deficiency is hypothyroid. Blood taken from the umbilical cord or collected by heel prick within the first few days of life can be placed on filter paper, sent to a reference laboratory, and

measured for content of either thyroxine or TSH.

In areas of iodine deficiency the tests will suggest high prevalence of neonatal hypothyroidism frequently (upto 10%). The main application of neonatal screening in iodine deficient areas is for epidemiological monitoring.

3. Radioiodine uptake

This test is widely used in industrialized countries to measure the avidity of the thyroid for iodine.

4. Ultrasonography

Ultrasonography, a means of obtaining an image of the thyroid size by ultrasound wave, can provide a more accurate assessment of thyroid size. However, it requires a trained operator, expensive equipment, and is not often practical for routine use in surveys.

5. LABORATORY INVESTIGATIONS

1. ESTIMATION OF CREATININE IN URINE (FOLIN'S METHOD) :

Reagents : 1. Picric acid 1.0 %

2. Sodium Hydroxide 10.0 %

3. Standard creatinine solution

(Working Standard solution containing 100 ug/ml. of creatinine).

PROCEDURE :

One ml. of urine is diluted with distilled water to 100 ml. It is mixed well and 5 ml. (equivalent to 0.05 ml. urine) liquid is pipetted into a test tube. To this is added 2.5 ml. of 1 % picric acid followed by 0.5 ml.of 10 % Sodium hydroxide. The contents of the tube are then mixed well. Colour is allowed to develop for 20 minutes. The volume is then made upto 10 ml. with water, and the intensity of yellow colour developed is read at 540 mu in colorimeter. A blank is prepared using 5 ml. of water instead of urine. A standard curve is prepared by using dilute creatinine standard solution. Range is 10-50 ug/ml. The amount of creatinine in the sample is calculated from this standard graph.

The calculation is done as follows :-

Amount of creatinine calculated from standard graph X 20 (Dilution factor) = Amt. of creatinine (ug/ml) **(Source : Karmakar et al, 1986).**

2. ESTIMATION OF IODINE IN URINE :

Chemicals and Reagents

1) POTASSIUM CARBONATE - K_2CO_3, 2.5 N. (A.R. Grade).
2) CERIC AMMONIUM SULPHATE - 0.005N, (A.R. Grade)
3) SODIUM META-ARSENITE - 0.035N, (A.R. Grade)
4) STOCK IODINE - 100 mg/100ml. (A.R. Grade)

PROCEDURE :

1) Pipette out 100 ul urine sample in each tube.
2) Add standard and blank to the respective tubes (as per protocol prepared)
3) Add 300 ul of K_2CO_3 to each tube of vertex.

4) Keep the rack at 80°C overnight for evaporation.

5) Keep the same rack for ashing in the furnace at 600°C for 2 hours.

6) Switch off the furnace, let the temperature be lower down, then take out the rack from the furnace.

7) Add 3 ml of sodium meta arsenite and centrifuge the tubes at 2500 rpm for 7 minutes and collect the supernatant in respective tubes.

8) Incubate the supernatant containing tubes for 5 minutes at 56°C.

9) Add 3 ml of cerric ammonium sulphate at 30 sec interval to each tube, mix and replace the tubes.

10) EXACTLY AFTER 20 MINUTES measure the transmittance at 420 mu against water blank (BLUE FILTER).

CALCULATION :

The amount of iodine/ml i.e. ug/ml is found with the help of calibrating tables. The amount of Iodine/g creatinine is calculated as follows :

$$\frac{\text{Amount of Iodine (ug/ml)}}{\text{Amount of creatinine(ug/ml)}} \times 10{,}00{,}000 = \text{Amount of Iodine (ug/g creatinine)}$$

(Source : Karmakar et al, 1986)

3. DETERMINATION OF IODINE IN WATER :

REAGENTS :

1. Standard NaCL : 20 %
2. H_2SO_4 : 60 % (V/v)
3. Arsenious Acid : (0.1N)
4. Ceric Ammonium Sulphate : (0.02N)
5. Ferrous Ammonium Sulphate : 1.5 % in 0.6 % H_2SO_4
6. Potassium thiocyanate : 4 %

PROCEDURE

1. Take 7.0 ml. of simple water in test tube
2. Add 1 ml. of 20 % NaCL
3. 0.5 ml. of 60 % H_2SO_4

4. 0.5 ml. of Aresenious Acid.

Keep in the waterbath at 30°C, add 1 ml of ceric ammonium sulphate. Exactly after 20 minutes add 1 ml. of ferrous ammonium sulphate to stop the reaction. Add 0.5 ml. of pot.thiocynate to get a brick red colour. Read this with a green filter at 550 mu **(Source : Karmakar et al, 1986).**

4. DETERMINATION OF IODINE IN SALT :

REAGENTS

1. Sodium thiosulphate - $Na_2S_2O_3$ (A.R. Grade)
2. Concentrated sulphuric acid- H_2SO_4 (A.R. Grade)
3. Potassium iodide - KI,(A.R. Grade)
4. Soluble chemical starch
5. Boiled double distilled water, (pharmaceutical grade)

The approximate cost of reagents would be US $ 25 which would analyse 200 salt samples.

PREPARATION OF REAGENTS

1. Sodium thiosulphate ($Na_2S_2O_3$)

Dissolve 1.24 grams $Na_2S_2O_3$ in 1 litre boiled double distilled water. This volume is sufficient for testing 200 salt samples.

Store in a cool, dark place, properly stored, solution can be kept for a year.

2. Sulphuric acid 2N (2H. H_2SO_4)

To 90 ml double-distilled water add 5.56 ml concentrated H_2SO_4 slowly. Add boiled, double-distilled water to make 100 ml. This volume is sufficient for testing 100 salt samples. Store in a cool dark place. The solution may be kept indefinitely.

CAUTION : To avoid violent and dangerous reaction always add the acid to water, never water to acid.

3. Potassium iodide (KI)

Dissolve 100 grams KI in 100 ml double-distilled water. This volume is sufficient for testing 20 salt samples.

Store in a cool, dark place, properly stored solution may be kept for 6 months.

4. Soluble Chemical Starch

Prepare 100 ml of saturated salt (NaCL) solution as follows. Dissolve sodium chloride (NaCL)reagent in 100 ml boiled, double-distilled water.

While stirring, add NaCL until it no more dissolves. Heat the solution till NaCL crystals form on the side of the vessel. Dissolve 1 gram of crystals in boiled, double-distilled water to make 100 ml.

Dissolve 1 gram chemical starch in 10 ml boiling double-distilled water. Add the NaCL solution to make 100 ml starch solution.

This volume is sufficient for testing 20 salt samples. Prepare fresh starch solution every day, since it cannot be stored.

Procedure

1. Carefully weigh 10 grams of the salt to be tested.
2. Pour the salt into a 50 ml measuring cylinder.
3. Slowly add boiled, double-distilled water.
4. Shake to dissolve the salt completely.
5. Add more water to make 50 ml.
6. Pour the salt solution (50 ml) into a conical flask with stopper.
7. Pipette out 1 ml of 2.N sulphuric acid. Add this to the salt solution.
8. Pipette out 5 ml of 10 % potassium iodide and add to the salt solution.
9. The solution turns yellow. Close the flask with the stopper and put it in the dark for 10 minutes. A closed box, cupboard or drawer may be used.
10. Pour sodium thiosulphate into the burette.
11. Adjust the lever to "0" and after 10 minutes, take the flask out of the dark shaking the flask, titrate with sodium thiosulphate.
12. Stop titration as soon as the solution turns pale (becomes very light yellow)
13. Add 1 to 5 ml of 1 % starch solution
14. The solution turns deep purple.
15. Continue titration until the purple colouration disappears and the solution becomes colourless.
16. Note the burette reading.

17. Read the iodine content of the sample in parts per million from the tabel given on the following pages.

Reporting

As you have seen, iodine testing is easy and takes only about twenty minutes per sample.

Maintaining accurate records is as important as the testing itself. Record your results in a register, indicating

- date of testing
- sample number
- salt manufacturer's name
- batch number of the salt
- date of iodation
- where the sample was taken from
- date of sampling and, finally
- the level of iodine in the sample.

Make daily reports of your findings, and immediately alert your supervisor if you find less than the prescribed level of iodine. Your report will initiate a series of legal and other actions to protect the consumer. A delay on your part will delay these actions and harm the consumer **(Source : UNICEF, 1985).**

Table showing iodine content (ppm) as per burette reading

Burette reading	Parts per million	Burette reading	Parts per million
0.0	0.0	3.0	31.7
0.1	1.1	3.1	32.8
0.2	2.1	3.2	33.9
0.3	3.2	3.3	34.9
0.4	4.2	3.4	36.0
0.5	5.3	3.5	37.0
0.6	6.3	3.6	38.1
0.7	7.4	3.7	39.1
0.8	8.5	3.8	40.2
0.9	9.5	3.9	41.3
1.0	10.6	4.0	42.3
1.1	11.6	4.1	43.4
1.2	12.7	4.2	44.4
1.3	13.8	4.3	45.5
1.4	14.8	4.4	46.6
1.5	15.9	4.5	47.6
1.6	16.9	4.6	48.7
1.7	18.0	4.7	49.7
1.8	19.0	4.8	50.8
1.9	20.1	4.9	51.9
2.0	21.2	5.0	52.9
2.1	22.2	5.1	54.0
2.2	23.3	5.2	55.0
2.3	24.3	5.3	56.1
2.4	25.4	5.4	57.1
2.5	26.5	5.5	58.2
2.6	27.5	5.6	59.2
2.7	28.6	5.7	60.3
2.8	29.6	5.8	61.4
2.9	30.7	5.9	62.4

Contd.....

Contd.....

Burette reading	Parts per million	Burette reading	Parts per million
6.0	63.5	8.0	84.6
6.1	64.5	8.1	85.7
6.2	65.6	8.2	86.8
6.3	66.7	8.3	87.8
6.4	67.7	8.4	88.9
6.5	68.8	8.5	89.9
6.6	69.9	8.6	91.0
6.7	70.9	8.7	92.0
6.8	71.9	8.8	93.1
6.9	73.0	8.9	94.2
7.0	74.1	9.0	95.2
7.1	75.1	9.1	96.3
7.2	76.2	9.2	97.3
7.3	77.2	9.3	98.4
7.4	78.3	9.4	99.5
7.5	79.4	9.5	100.5
7.6	80.4	9.6	101.6
7.7	81.5	9.7	102.6
7.8	82.5	9.8	103.7
7.9	83.6	9.9	104.7

(Source : UNICEF, 1985)

6. TREATMENT OF THE INDIVIDUAL PATIENT WITH ENDEMIC GOITRE

(Source : Riccabona, 1985)

At present a variety of efficient and safe therapeutic programs are available for treatment of almost all kinds of thyroid diseases. In a virtually goitre-free country every goitre is approached as an endocrine or neoplastic disease, and intensive treatment is therefore begun immediately. In regions with an incidence of goitre of upto 90% such an approach is not justified.

The intensity of symptoms and signs of compression on structures surrounding the goitre are not necessarily dependent on goitre size. Other signs may also be observed in goitrous people like disorders of thyroid function such as hyperthyroidism (often due to toxic adenomas), hypothyroidism, thyroiditis (subacute, sometimes abscesses), and malignancy may be observed in endemic goitre regions.

Patients with asymptomatic goitre may profit from prophylactic efforts and possibly some follow-up, but therapy is not necessarily required. Patients with symptomatic goitre should be treated in the same way the world over.

It should be realized that the cost and personal effort involved in treatment of endemic goitre according to modern standards are considerable and may limit the kind and extent of treatment provided in some densely endemic goitre areas of the world.

Treatment in Developed Countries

Treatment should be started only after an exact diagnosis has been established by clinical examination, thyroid function test, and assessment of tracheal obstruction by radiography.

Indication for Medical Theraphy in Developed Countries

Grade II thyroids without clinical symptoms, juvenile goitres, goitres with a doubtful relation to the patients' symptoms, and goitres with a recent tendency to further growth should always be treated with thyroid hormone providing thyroid function is normal and malignancy or purulent thyroiditis can be excluded, and providing the tracheal diameter is reduced not more than one-third of its normal width. There is no condition prescribing medical theraphy

except suspected malignancy, hyperthyroidism and severe dyspnoea due to tracheal stenosis.

In pregnancy, medical theraphy does no harm to the foetus and the mother. Patients after thyroid surgery living in endemic areas should always be given life-long thyroid hormone medication in order to avoid a recurrence of the goitre. Patients with hypothyroidism and goitre should be treated with thyroid hormone also, unless there is a suspicion of cancer or evidence of severe tracheal compression.

Medical therapy of hyperthyrodism is usually unnecessary. In endemic regions hyperthyroidism usually occurs in large nodular glands, and in those, surgery yields better results. Thyrostatic medication will occasionally be the treatment of choice in juvenile hyperthyroidism in an endemic area or in patients who should have radio iodine therapy, but cannot be treated with the radionuclide because of previous iodine exposure. It is essential that a patient given this kind of therapy, be cooperative in order to avoid side-effects such as further growth of the goitre, leukopenia, and so on. Subacute thyroiditis and Hashimoto's thyroiditis are treated by appropriate medication as in goitre-free countries.

Indication for Surgery in Developed Countries

Surgery should be considered when there is an impairment of the tracheal lumen of more than one-third of its normal width, if accompanied by symptoms such as dyspnoea which cannot be attributed to other pathological conditions. Surgery is obligatory whenever malignancy is suspected. It is the treatment of choice for toxic adenomas and large nodular goitres with hyperthyroidism. In these patients thyroid functions should be normalized prior to surgery by thyrostatic drugs. Cold nodules, which are not accessible to medical theraphy, are better treated surgically. Cosmetic considerations should be admitted only with reluctance in the choice of therapy, but cannot be dismissed completely. Grave's disease should be treated in endemic goitre regions as elsewhere, but surgical or radio iodine therapy will be chosen more frequently than in goitre free countries because of the size of the glands.

Indication for Radio Iodine Therapy in Developed Countries

Radioiodine should be used only for treatment of endemic goitre in patients who are at high risk for general or local

complications at surgery. Thus, indications might be old age, cardiac or other diseases prohibiting surgical intervention, and recurrent goitres with fibrosis from previous interventions.

In some instances it seems beneficial to combine surgery and radio iodine therapy for treating recurrent disease. For example, a cold nodule on the side of a paralytic vocal chord can be removed surgically, while the warm part of the goitre on the side of the intact vocal chord can be reduced in size by radio iodine therapy. A cold pyramidal lobe recurrence can be excised without risk of complications, while the remaining recurrent goitre which is responsible for tracheal stenosis can be treated with radio iodine therapy.

An absolute contra indication of radio iodine therapy is an existing pregnancy. While no significant carcinogenic effects of radio iodine therapy have been reported, we usually avoid this kind of treatment in patients below 40 years of age.

Severe thyrotoxicosis and nodular goitre should not be treated primarily with radio iodine therapy, since there is a risk of thyroid storm or of fatal cardiac failure during the several weeks to months between therapy and normalization of thyroid function. In view of the delayed effects of radio iodine therapy it is essential to follow up the patient for many years. This therapy should be recommended only when the patient is willing to have regular follow-up studies over a long period of time.

7. THE INTERNATIONAL COUNCIL FOR CONTROL OF IODINE DEFICIENCY DISORDERS (ICCIDD) : A BRIEF DESCRIPTION

Purpose

To eliminate iodine deficiency.

History and background

ICCIDD came into being informally in 1985 in New Delhi when a regional meeting on iodine deficiency disorders in Southeast Asia, sponsored by UNICEF and WHO, agreed that action to control IDD should be accelerated.

Since its inception, ICCIDD has worked closely with multilateral agencies, particularly UNICEF and WHO. It reports annually to ACC/SCN of the United Nations, and works closely with multilateral and bilateral agencies in fostering the development of national programmes. Currently, principal funding comes from UNICEF,AIDAB, CIDA and WHO.

Global activities

1. General coordination and administration:
2. Advocacy and fund raising:
3. Expert groups:
4. Training:
5. Applied research and development:
6. Global monitoring:
7. Publications:
8. Technical meetings:
9. Liaison with agencies:

Regional activities

Regional task forces for IDD correction have been developed for the Americas, Africa, Southeast Asia and China. In these, ICCIDD works closely with UNICEF, WHO, other agencies and national programs in the region.

National activities

ICCIDD recognizes that the primary and final responsibility for national IDD control programs is with the national governments.

ICCIDD now offers a continued specific commitment to be available to countries to assist in all aspects of the establishment of national programmes as requested by their governments. This expert assistance can include assessment of current IDD status and control, assessment of the role of the salt industry in relation to an existing or future programme, and advice on communication and education, on planning, on establishment of national IDD control commissions, on technical aspects of implementation methods, and on programme monitoring and evaluation.

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ANNEXURES

Annex - I

SCHEDULE OF ACTIVITIES AT SEMINAR CUM WORKSHOP

IODINE DEFICIENCY DISORDER (IDD) IN GUJARAT

Seminar - cum - Workshop

Date : 8-1-1994, Saturday.

Venue : Department of Preventive and Social Medicine,
Government Medical College, Surat.

PROGRAMME :

	Programme	Time (Hrs.)
(1)	Registration	9.30 - 10.00
(2)	IDD and Control Programme in Gujarat	10.00 - 10.30
(3)	Lecturers of guest speakers	10.30 - 13.30
(4)	Formation of groups and group discussion	14.30 - 15.30
(5)	Compilation of group deliberations	15.30 - 16.30
(6)	Concluding session	16.30 - 17.00

Annex - I

Detailed Programme

	Programme	Speaker
(1)	Registration	
(2)	IDD and Control Programme in Gujarat	Dr. D Bhatt
(3)	Lecturers of guest speakers :	
	a Social and economic aspects of IDD Control in India.	Dr. C S Pandav
	b. IDD indicators	Dr. M G Karmakar
	c. Epidemiology of IDD	Dr. V K Desai
	d. Present situation of salt iodisation activity in India	Shri L Jadham
	e. Salt iodisation	Shri K M Majeethia
	f. Salt Manufacturer's point of view	Shri S C Upadhyay
(4)	Formation of groups and group deliberations	Dr. Pradeep Kumar
(5)	Compilation of group deliberations	
(6)	Concluding session	

Annex - I

"IDD in Gujarat" Seminar-cum-workshop

Formation of working groups
Co-ordinator : Dr. Pradeep Kumar

Group No. 1	Training and Manpower Development
Resource person	Dr. V K Desai
Rapporteur	Dr. V Majmudar
Group No. 2	Programme Planning Implementation and Legislative support
Resource person	Dr. C S Pandav
Rapporteur	Dr. M P Singh / Dr. R K Baxi
Group no. 3	Development of Regional Laboratories
Resource person	Dr. M G Karmarkar / Dr. T M Chary
Rapporteur	Dr. G P Kartha
Group No. 4	Community Participation
Resource person	Dr. G S Bildhiya
Rapporteur	Dr. N J Talsania

Annex - II

REPORTS OF WORKING GROUPS

Group 1 - Training and Manpower Development

Aim : - To identify the problem and its assessment.

- To impart education regarding its importance.

Need : - To impart knowledge.

- To observe uniformity.

Assessment :

1. To develop a standardized system of evaluation
2. To level of knowledge and
3. Available manpower.

Training to whom :

I Level : 1. ICDS workers
2. MPWs
3. School teachers
4. Community and NGOs

II Level : 1. CDPOs (ICDS)
2. Health Supervisors / Mukhya Sevikas (ICDS)
3. MOs at PHC / CHC

I Level : 1. District / Regional level officers
2. Teachers of Medical Colleges

Type of training :

(A) Problem assessment

(Audio - visual slides, video cassettes, posters)

Manuals in vernacular

(B) Health education

- Need for iodized salt

Additional inputs :

- Periodical multidisciplinary meetings for exchange of information
- Inclusion of medical students as potential problem evaluator
- Periodic update.

Annex - II

Group 2 - Programme planning, implementation and legislative support.

Suggestions made by the group are as follows :

1. Uniform guidelines should be made for prevalence surveys
2. Repeat prevalence surveys should be carried out every 5 years, when IDD is a public health problem
3. Network of surveillance to be established through primary health care
4. Salt samples from households to be collected by AWW/MPW and from retailers and civil supply department
5. Strict sample checking at manufacturers and retailers level
6. Legislation can't make behavioral changes so awareness through health education and strong publicity by use of mass media is required. Although the legislation at manufacturer's level for proper iodisation is required.
7. Cheap and uniform method of iodised aslt production is to be implemented.
8. Alternatively to check the losses during transportation, non iodised salt is to be supplied to each state at an accessible and convenient point where it can be iodised and redistributed throughout the state.
9. iodised salt should be supplied in small family packing. Edible salt to be transported at par with other parishable food itmes like vegetable.
10. Alternative methods of providing iodine can be considered in high endemic areas viz.

    (1) Iodised water at school + iodisation of municipal water supply.

    (2) Iodised oil - oral or injectible
11. More stable iodising salt should be used for iodisation to prevent loses during transport and storage.

Annex - II

Group 3 : Development of Regional laboratories.

1) Grass root level :

(1) Disseminate proper training to medical officers and paramedical staff to develop orientation and the 'eye' to look for and identify the IDD case at early stage.

(2) Collection of samples and transportation to the district level facility (Hospital / Medical college).

2) District level :

District hospital should have facilities, instruments, trained personnels and funds to analyse urine samples for iodine.

3) Medical college level :

(1) Regular training facilities to provide technical personnel at district level.

(2) Regular quality control measures to check the dependability of these tests.

(3) There should be a centre where sophisticated facility to analyse T_3, T_4, TSH levels in special cases (not for routine screening).

To start with, focal point will be the medical colleges which should have urine analysis facilities and training programmes. At a later stage, this should percolate to the district level.

Annex - II

Group 4 : Community participation

1. Through mass media (TV/Radio/Newspaper).

An awareness is to be created about the problem, identification of cases and preventive value of iodised salt.

2. Iodisation of water in small quantities in school has been tried with success in Thailand.
3. Information about the problem to be disseminated by school authorities. Also the educational material be displayed in the schools. Information reports should be sent to health authorities.
4. AWWs and trained dais be trained and educated properly to spread the awareness.
5. Workers of CSSM programme may be involved in the activities alongwith the their routine activites.
6. Participation of community leaders like sarpanchs, religious leaders be ensured.
7. Priority determination should be area specific.
8. Participation from public at manufacturer, distributor and consumer level.
9. Salt companies as their social obligation should finance the activities for awareness generation.
10. Labels on salt packets should have appropriate messages.
11. Quality control at consumer level be ensured.
12. Legal enforcement of universal sale of iodised salt.
13. Analysis of health seeking behaviour of community be studied.
14. Periodic impact analysis at 5 yrs. interval.
15. Recommend the registration of IDD cases and their follow-up.

Annex - III

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